Power Engineering

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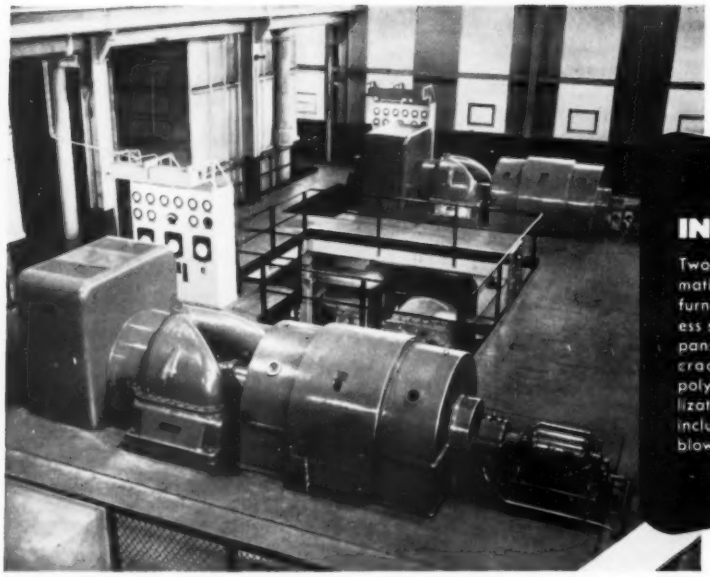
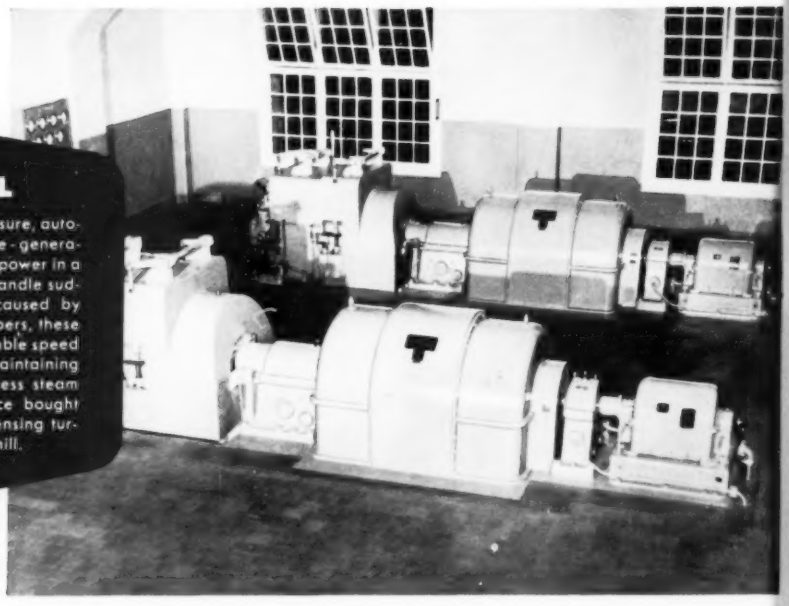
"Meeting Industry's



IN AN OIL REFINERY

Two Elliott 4000-kw condensing, automatic-extraction turbine-generator units furnish the power and much of the process steam required by a tremendous expansion program involving a big cat cracker and new crude, distillation, polymerization, gas recovery and stabilization units. Other Elliott equipment included in the project: turbine-driven blowers, condensers, etc.

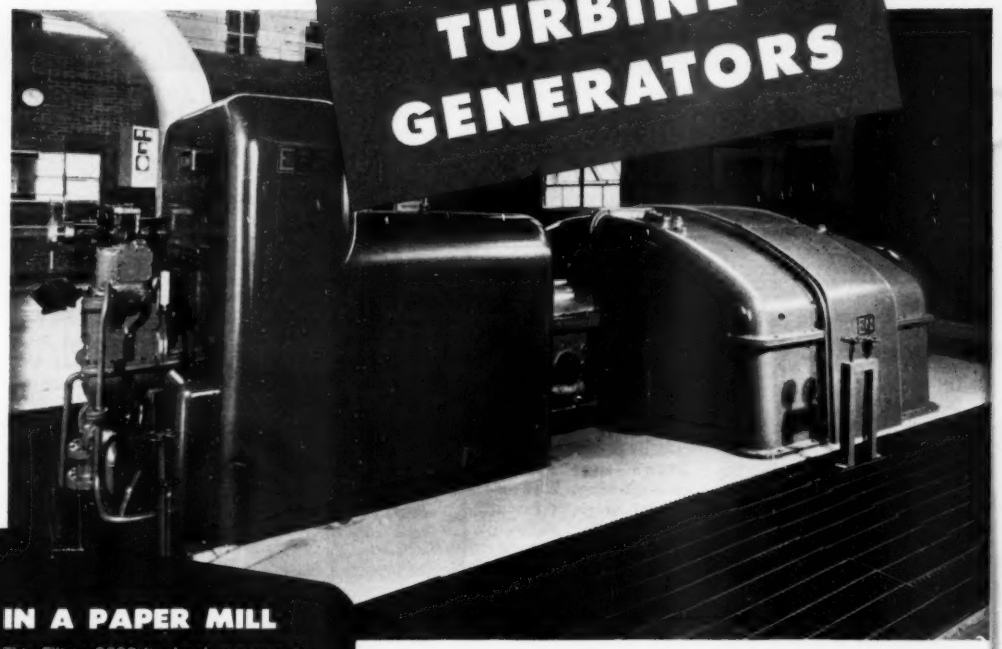


IN A PULP MILL

Two Elliott 2000-kw back pressure, automatic-extraction type turbine-generators were installed to provide power in a modernization program. To handle sudden electrical peak loads caused by modern log barkers and chippers, these turbines have sensitive and stable speed control, at the same time maintaining pressure control for the process steam load. This company has since bought two Elliott 3500-kw noncondensing turbine-generators for another mill.

varying power needs"

ELLIOTT TURBINE-GENERATORS



IN A PAPER MILL

This Elliott 2000-kw back-pressure turbine-generator is the first step in a new power generating program. It now runs in parallel with outside power, which maintains frequency and takes the electrical load swings. Future expansion calls for a duplicate generator driven by a condensing, extraction-type turbine, giving a flexible power and process steam combination in the power plant.

Producing economical power, as a by-product of process steam is the job of a properly applied turbine-generator in an industrial power plant. Elliott engineers will help you work out a type or combination of generating units which will fit the electrical and steam needs of your plant. You'll be proud of your Elliott turbine-generator's operating record.

ELLIOTT Company

Steam Turbine Dept.
JEANNETTE, PA.

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H2-5

A STEAM TRAP CASTS A MIGHTY BIG SHADOW!

THINGS STEAM TRAPS AFFECT	REASON	HOW ARMSTRONG TRAPS MEET THE NEED	EXAMPLE
1 HEAT-UP OR START-UP-TIME	When steam is turned on, large amounts of condensate and air must be removed.	Condensate and air are discharged as fast as they reach trap.	*40 Minutes Faster Heat-up* of drying oven at pharmaceutical plant with Armstrong "Blast" traps.
2 RATE OF PRODUCTION	Quick heat-up, maximum temperatures essential for maximum output.	Air and condensate discharged at steam temperature; equipment kept full of hot, dry steam.	*30% Greater Output* from jacketed kettles at Canadian plant since changing to Armstrong traps.
3 STEAM WASTE	When steam gets past traps, fuel is wasted, boiler capacity may be inadequate.	No steam ever reaches discharge orifice, even when there is no condensate load. Heat treated chrome steel valve parts, ground and lapped, resist wear, stay leak-tight for a long time.	*Steam Savings Eliminate Need for New Boiler* at chemical plant since installing Armstrong traps.
4 FUEL WASTE	Steam that blows through traps does no useful work, wastes fuel.		*33⅓% Reduction in Fuel Bill* after trapping vats with Armstrongs at Missouri plant.
5 CONTINUITY OF OPERATION	When traps are inoperative or down for repairs, unit being drained may be "off the line."	Nothing to clog, stick or collapse! Large orifice. Self-scrubbing action cleans out dirt, scale. "Frictionless" leverage, heavily reinforced. Wear and corrosion-resistant stainless trim.	*Maintenance Time Cut 30%* Illinois user says, "Unequalled dependability, simplicity of design means repairs can be made quickly" (with minimum equipment downtime).
6 MAINTENANCE COST	Traps that don't "wear well" take a lot of manhours for repair.		

BIG effects from little traps! And, the effects are multiplied by the number of traps in the plant you design or operate until they grow to be a major influence upon operating efficiency and economy.

Before you specify steam traps ask your nearby Armstrong Representative to call. He is qualified to give you practical assistance and answers that can save you a lot of time and trouble.

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The 44-page Armstrong Steam Trap Book gives complete data on trap operation, selection, installation, maintenance, safety factors, etc. Free on request . . . Write:

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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

This magazine was established in 1896 as Practical Engineer. The title was changed to POWER PLANT ENGINEERING in 1918, to POWER GENERATION in 1948, and to POWER ENGINEERING in May, 1950. Rights reserved to above titles

July, 1952

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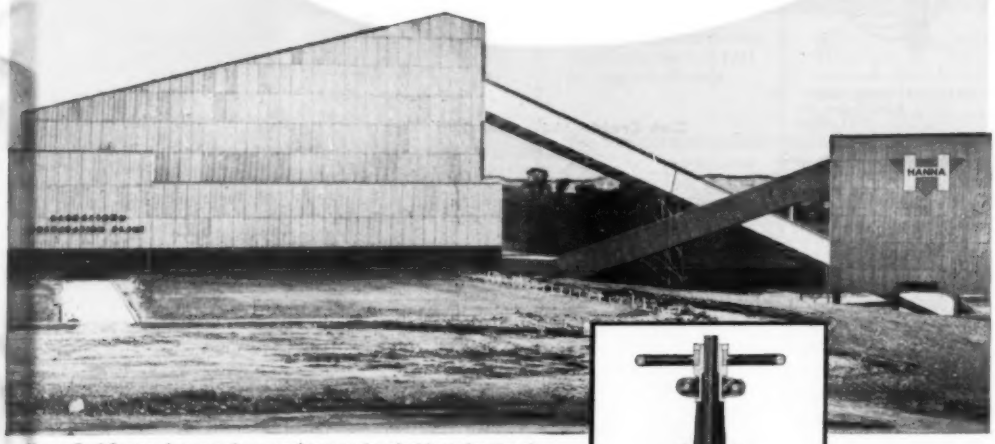
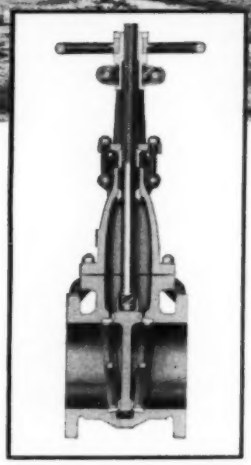
The only magazine devoted exclusively to the engineering interests and the practical problems of all power engineers

Hanna Coal Company Preparation Plant ... served by the OIC LONG LINE of valves



Hanna Coal Company's mammoth new coal preparation plant in service now at Georgetown, Ohio.



"We've standardized on OIC Valves; all kinds for all kinds of service. They're the best!"

Hundreds of OIC Valves—iron, bronze and steel—were used in this coal preparation plant, completed just a year ago. OIC Valves were selected by Hanna Coal Company after many years' experience with these valves at their other properties—evidence of the fine performance they provide.

Simplify your procurement problems by calling the nearby OIC distributor. The OIC Long Line offers the right valve for every job.

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WADSWORTH, OHIO

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FORGED AND CAST STEEL · IRON · BRONZE

ENGINEERS' PREVIEW

TRANSISTOR PRODUCTS, INC., a new subsidiary of Purolator Products, Inc., Rahway, N. J., will manufacture the transistor, which is a pea-sized substitute for vacuum tube. It has purchased a license from Western Electric Co., Inc.

One important future application of the transistor lies in its use as a rectifier in an entirely new and trouble-free ignition system for internal combustion engines, eliminating brushes and moving parts that cause most failures.

☆ ☆ ☆

POWER ENGINEERS are going to see increases in the use of micro-wave radio equipment by industry for communications and remote metering and control, particularly in such far-flung operations as electric power and oil pipe line systems. This equipment was demonstrated by RCA Victor Division, Radio Corporation of America in an extensive exhibit at the 24th joint annual conference of the Petroleum Industry Electrical Association and the Petroleum Electric Supply Association, at Tulsa, Okla., in April.

The exhibit showed how microwave, an ultra-high-frequency radio relay system, best known for its use as a relay link in radio, television, and telegraph communications, is rapidly finding many new applications. Almost any information that can be converted into electrical impulses, such as pressure, temperature, engine speed, and so on, can be automatically transmitted by means of microwave radio relays from various places to a central location, where recorders are set up to give instantaneous readings. By the same means, operators guided by these readings can start, stop, or regulate equipment in operation at these remote, unattended stations. Also demonstrated was an industrial television camera chain, which is finding increasing uses in industry to monitor plant processes.

☆ ☆ ☆

BUREAU OF RECLAMATION plans for construction of the 33,000-kw Eklutna power plant in Alaska and has called for bids. This plant will provide badly-needed defense and industrial power for the Anchorage area. It is planned to have the plant in operation by spring or summer 1954. A pressure tunnel 4.5 miles long is already under construction to divert water to the plant site through a mountain chain westward from Lake Eklutna.

☆ ☆ ☆

THE BABCOCK & WILCOX CO. will now be found in its new headquarters in the recently completed 32-story Chrysler Bldg. East at 161 East 42nd St., New York City, instead of at the old familiar address at 85 Liberty St.

Sales offices of the company's Tubular Products Division will not be affected by the move, and will remain in their present location at 22 East 40th St.

☆ ☆ ☆

H. M. RIVERS, assistant director of engineering service, Hall Laboratories, Inc., will be the new director of engineering service. He succeeds J. N. Welsh, who as assistant director of Hall Laboratories, Inc., recently assumed new business administration duties in this firm.

☆ ☆ ☆

THE DUNELLEN, N. J. plant of Worthington Corp. will be redesignated as the Plainfield Works. To provide proper designation, the name and address of this plant, effective immediately, will be: Worthington Corp., Plainfield Works, Plainfield, N. J.

☆ ☆ ☆

CONSOLIDATED EDISON, Westchester Lighting Co., the New York Telephone Co. and others, will use a system developed by Stevens & Wood for mapping utility properties. Master maps are made on vinylite plastic for long life and easy reproducibility. The maps precisely locate, dimension, record occupancy and customer data, and date all services and facilities on a grid system covering the entire area served by the utility. A single set of maps — in 23- by 25-in. sections and usually scaled in the 50- to 200-ft per in. range — replaces card and other record systems which may be unusually cumbersome, hard to keep up-to-date, and often incomplete. Perhaps a modification of this plan would also prove useful in industrial plants for recording complex piping systems as well as electric distribution systems.

☆ ☆ ☆

EDWARD J. DOYLE, Chicago, Ill., president and director of the Commonwealth Edison Co., will be a Doctor of Laws. He received the degree from the University of Notre Dame at the Commencement Exercises held this June in the Notre Dame Stadium. In addition to his position as president and director of the Commonwealth Edison Co., he is a member of the Executive Committee of the Association of Edison Illuminating Companies.

☆ ☆ ☆

ALLIS-CHALMERS Manufacturing Co. will install a 22,000,000 volt betatron in a new 86- by 74-ft concrete building at the West Allis Works. It will be used for inspecting large steam turbine, centrifugal pump and hydraulic parts produced by the firm.

☆ ☆ ☆

DR. KARL B. MCEACHRON, of the General Electric Co., will henceforth be known as the outstanding engineer resident in New England. He is shown being presented the annual award for 1952 of the Engineering Societies of New England. He is manager of the company's Laboratory - Engineering Department, Transformer and Allied Products Division, Pittsfield, Mass. Dr. McEachron was cited as "an electrical engineer who

Dr. McEachron, outstanding engineer resident in New England, at the award presentation in Boston with Phillip Rugg (at left), ESNE president, and Kerr Atkinson (right), chairman of the award committee

has won new laurels for his country as a pioneer in the understanding and control of natural lighting; a prodigious contributor to the art; and a devoted servant of his profession." The award is selected by committee votes from nominations submitted by various engineering societies affiliated with the ESNE.

☆ ☆ ☆

IRVING S. OLDS, having reached the corporation's retirement age, retired May 6 as chairman of the board of directors. Benjamin F. Fairless will be the new chairman of the United States Steel Corp.

Mr. Olds will resume the active practice of law with the New York law firm of White and Case, of which he has been a member since 1917.

Mr. Fairless will continue to serve as president of the corporation, a position he has occupied since January 1, 1938. He will also continue as president of United States Steel Co., the steel operating subsidiary.

Mr. Fairless will also receive the 1953 John Fritz Medal and Certificate as Champion of the American Free Enterprise System for Notable Industrial Achievement in the Production of Steel.

The John Fritz Medal was established in 1902 by friends of John Fritz on the occasion of his 80th birthday to honor him for his great contributions in the manufacture of steel and in the advancement of industry generally.

This award to Mr. Fairless will culminate a long series of honors bestowed upon him for his achievement and leadership in the production of steel. Presentation of the award will be made at the Centennial meeting of the American Society of Civil Engineers in Chicago in September. Mr. Fairless is a member of the Society.

☆ ☆ ☆

A. R. ROYLE will be General Manager and member of the Board of Directors of the Gai-Tronics Corp., Reading, Pa. His promotion has been announced by L. D. Staver, president of Gilbert Associates, Inc., parent company to Gai-Tronics.

☆ ☆ ☆

THE PETRO oil burner business will henceforth be part of the Iron Fireman Manufacturing Co. The entire line of Petro oil burners and oil heating equipment will be manufactured in Iron Fireman's Cleveland plant. The oil burner company will become the Petro Division of the Iron Fireman Manufacturing Co.

☆ ☆ ☆

THE FEDERAL GOVERNMENT and the military services will now use nationally-recognized industry and technical society standards "to the maximum extent practicable" in developing Federal and Military Specifications and Standards.

This statement was made by Willis S. MacLeod, director of the Standards Division, Federal Supply Service of General Services Administration, in an address to the Standards Council of the American Standards Association in New York, April 18.

Mr. MacLeod called it the most significant step ever taken in government standards work in the past 30 years. "For the first time," he said, "there is official recognition, supported by statute, that nationally-recognized standards and specifications shall be used."

☆ ☆ ☆

HARRY E. LEWIS will be the new executive director of the Industrial Mineral Wool Institute. Mr. Lewis' most recent position was that of general manager of the industrial sales department, Perlite

Harry E. Lewis, who will be the new Executive Director of the Industrial Mineral Wool Institute

Division, Great Lakes Carbon Corp., New York City. Prior to that he had been manager of the insulation engineering department of The Eagle-Picher Sales Co., Cincinnati, Ohio. He had also been associated with Owens-Corning Fiberglas Corp., Toledo, Ohio.

He has been a member of the Technical Committee of the Institute from the time it was founded in 1941 to 1949 and has continued to take an active interest in Institute affairs since that time.

☆ ☆ ☆

WALTER KIDDE Nuclear Laboratories, Inc., will be the first privately-financed organization dedicated to research in nuclear power. The laboratories will perform research, development and experimentation in the field of nuclear energy. The services of the firm will be available to other organizations interested in the design of nuclear power plants or in applications of nuclear technology to their products and processes.

☆ ☆ ☆

THREE 24,000,000-volt betatrons, the first ever built for industrial operation, used in Eastern and Midwestern steel foundries, will help speed the production of vital armor steel castings required in the Army's tank program.

Powerful enough to penetrate 7 to 9 in. of armor steel in a little more than a minute, the new X-ray giants will greatly speed and improve inspection techniques formerly requiring hours and days in some cases, it was reported by the Steel Founders' Society of America, the principal technical and research organization of the steel casting industry.

The three massive units are being operated for the Army in armor-producing plants of General Steel Castings Corporation at Granite City, Ill., and Eddystone, Pa., and by Continental Foundry and Machine Company, at East Chicago, Ind.

☆ ☆ ☆

A NEW radiochemicals division of Bjorksten Research Laboratories, established at Madison, Wis., will conduct research in lubricants. What happens when a lubricant is placed in a piece of machinery in operation may seem at first glance to be a simple question, but lubricant makers are only too familiar with the extreme difficulty of answering all questions which even a simple lubrication problem may pose. Lubrication problems are particularly adapted to study by radiotracer techniques, which give answers in quick time to questions of great complexity.

☆ ☆ ☆

A LARGE WAREHOUSE will now be saved by getting its temperature back up again. It recently seemed doomed to destruction from a strange cause — freezing. The building was being used for quick-freezing and storage and the low temperatures used on the ground floor rooms traveled down the supporting columns, freezing a solid block of ice eight feet thick beneath the floor — really a deep freeze. This caused movement as much as 8 in. in parts of the building. By installing heating cable and insulation on the floors and around the columns and maintaining a heating cycle, the building will be saved, according to *The Ohmite News*.

☆ ☆ ☆

COAL MAY BE MOVED to market by pipeline in the not-too-distant future, according to a coal industry magazine. An official of Pittsburgh Consolidation Coal Co., which is doing this work, says: "A pipeline for transporting coal will save considerable in transportation, and we should know by mid-summer how soon we can put such a line in commercial operation".

Such a large-scale experimental pipeline has been in actual operation in Ohio since November, moving coal a distance of about three miles. To move coal by this method, it is first finely crushed and mixed with water, and the thick mixture is then pumped through the pipeline. At the receiving end, the water is removed and the coal is ready for marketing.

☆ ☆ ☆

"The way I heerd it," says Sparling *Metrograms*, "is that the steam that blows the whistle never turns the wheel."

LEADING MANUFACTURERS HAVE HELPED "JOB PROVE" SUN TRANSFORMER OILS

Over the years, leading manufacturers of transformers have helped us "Job Prove" Sun Transformer Oils. They have found, through continuous use, that these Sun oils have the excellent heat-transfer characteristics needed to meet the requirements of today's transformers. In addition, they are highly stable and resistant to oxidation, completely dependable in protecting equipment and reducing maintenance and replacement.

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It's light! It's bright! It's right! You see instantly the accurate boiler water level in your Yarway Flat Glass Gage because *the meniscus at water level stands out like a brilliant star...* thanks to the new Yarway Type "M" Illuminator.

The Type "M" Illuminator is specially-designed to give maximum brilliance to Yarway flat glass inserts, and to spot the water level over its entire traverse. The superior penetration of its blue-white light cuts through extraneous light, dust particles in the air, and deposits on the gage glasses. Effective over longer distances.

New or already-installed Yarway Flat Glass Gages may be equipped with the Illuminator. Yarway Illuminators may be installed in pairs on four-glass gages.

Get in touch with your nearest Yarway office for further details on this latest Flat Glass Gage development, or write direct to...

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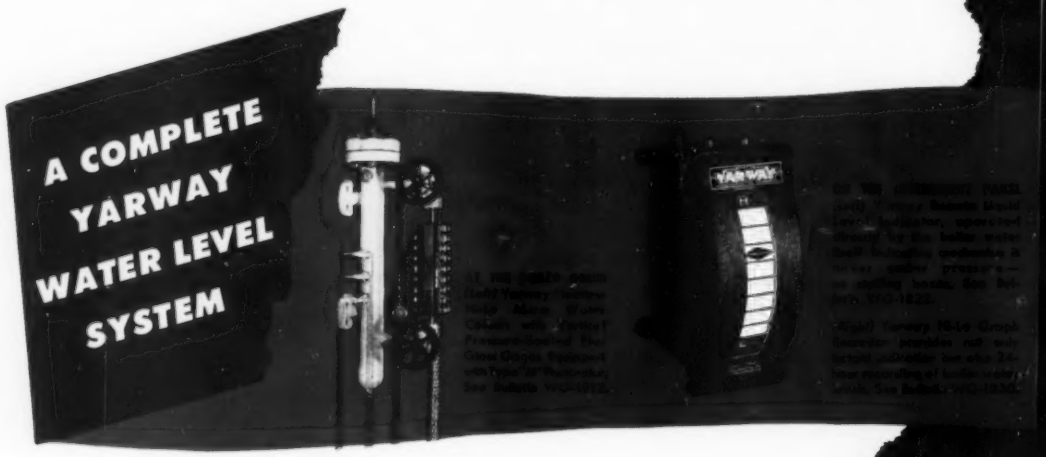


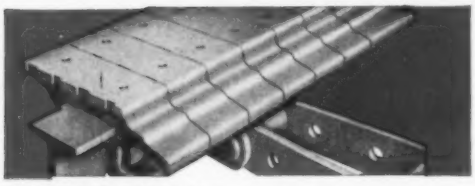
YARWAY STEAM

like a Star
TYPE "M" ILLUMINATOR ATTACHED
TO FLAT GLASS GAGE INSERT
YARWAY
YAR
WAY
PLANT EQUIPMENT

What has caused this tremendous SWING to Riley Traveling Grate Spreader Stokers?

As more and more Riley Traveling Grate Spreader Stokers have been placed in operation Riley Spreader Stokers are being selected by greater and greater numbers of the country's leading public utility and industrial plants—to such an extent that to date in 1952, Riley has sold more traveling grate spreader stokers than all other companies combined.

We believe the fundamental reason for this tremendous swing to Riley is that news of the excellent results and satisfactory performance of Riley Spreader Stokers has traveled rapidly from plant to plant. Such satisfactory performance is largely due to design characteristics and the vast experience of Riley in the stoker field.



THE GRATE SURFACE The grate surface is made up of small clips, two inches wide by six inch pitch, mounted on structural T bars. The use of small grate clips eliminates warping and cracking and assures low maintenance and long life by providing adequate cooling. Clips are of nickel-chrome alloy to minimize growth. A level grate surface and uniform air distribution results.

THE FEEDER-DISTRIBUTOR The feeder is designed to give uniform positive feed regardless of coal characteristics and moisture. Avalanching with fine coal does not occur. The overthrowing distributor gives uniform longitudinal and lateral distribution and prevents damage and outage caused by wedging of foreign materials between distributor and housing.

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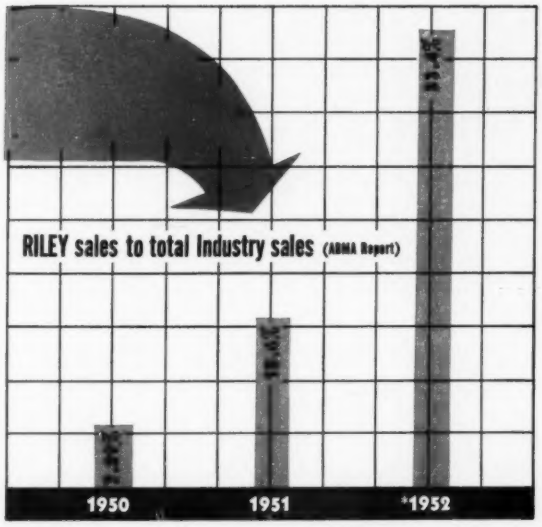
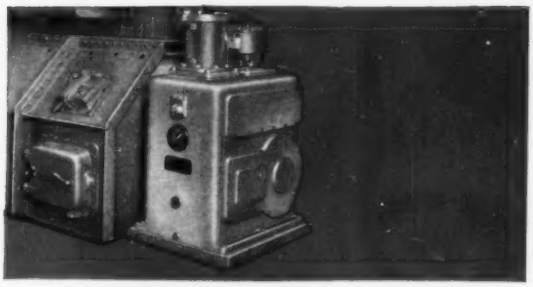


* First three months, latest available figures at time of ad preparation.



THE GRATE DRIVE The Riley grate drive is a hydraulically driven ratchet drive, completely enclosed and automatically lubricated. This simple rugged drive operates with practically no maintenance and is not susceptible to damage in case of grate obstruction. No sprockets, chains or speed reducers are required.

BACKED BY OVER 50 YEARS OF EXPERIENCE There are over 50 years of stoker designing and manufacturing experience back of the Riley Traveling Grate Spreader Stoker, dating back to the two first successful makes of stoker—the Murphy Furnace and the Jones Underfeed Stoker. Riley has been manufacturing traveling grate stokers for over thirty years.

We believe it will pay you to visit some installations before purchasing traveling grate spreader stokers.

All of these Companies have ordered Riley Traveling Grate Spreader Stokers

CARBIDE & CARBON CHEMICAL COMPANY
Whiting, Indiana

OHIO EDISON COMPANY
Springfield, Ohio—two orders

IOWA-ILLINOIS GAS & ELECTRIC COMPANY
Iowa City, Iowa

CELANESE CORP. OF AMERICA
Hopewell, Virginia

CLIFFS POWER & LIGHT COMPANY
Ishpeming, Michigan

IOWA PUBLIC SERVICE COMPANY
Carroll, Iowa

KENNECOTT COPPER COMPANY
McGill, Nevada

GENERAL ELECTRIC COMPANY
Richland, Washington

GARLOCK PACKING COMPANY
Palmyra, New York

SWIFT & COMPANY
Baltimore, Maryland

E. I. DUPONT DE NEMOURS & CO.
Savannah River Project, South Carolina

KAISER-FRAZER COMPANY
Willow Run, Michigan

B. F. GOODRICH COMPANY
Akron, Ohio

UTAH-IDAHO SUGAR COMPANY
Washington

ARMSTRONG CORK COMPANY
Lancaster, Pennsylvania

PENNSYLVANIA ELECTRIC COMPANY
Seward, Pennsylvania—three orders

OHIO EDISON COMPANY
Youngstown, Ohio

OTTERTAIL POWER COMPANY
Crookston, Minnesota

CHAMPION PAPER & FIBRE COMPANY
Canton, North Carolina

CENTRAL ILLINOIS LIGHT COMPANY
Springfield, Illinois

MONSANTO CHEMICAL COMPANY
Springfield, Massachusetts

GENERAL ELECTRIC COMPANY
Louisville, Kentucky

GAYLORD CONTAINER COMPANY
Bogalusa, Louisiana

JOHN DEERE & COMPANY
Alladin, Iowa

SWIFT & COMPANY
Charlotte, North Carolina

BROWN-LIPE-CHAPIN DIV.
GENERAL MOTORS COMPANY
Elyria, Ohio

U. S. GYPSUM COMPANY
Oakfield, New York

STOKELY FOODS
Indianapolis, Indiana

CATALYTIC CONSTRUCTION COMPANY
Fernald Project, Ohio

SANGAMO ELECTRIC COMPANY
Springfield, Ohio

UNIVERSITY OF MINNESOTA
Minneapolis, Minnesota

ROCHESTER MUNICIPAL PLANT
Rochester, Minnesota

CITY OF NAPOLEON
Napoleon, Ohio

CORN BELT POWER CO-OP.
Humboldt, Iowa

U. S. AIR FORCE BASE
Limestone, Maine

CITY OF AMES
Ames, Iowa

ALABAMA ELECTRIC CO-OP.
Andaluss, Alabama

JAMIESON COAL & COKE CO.
Farmington, West Virginia

SPOKANE WATER WORKS
Spokane, Washington

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Drop Forged Steels

W-S Screw-End and Socket-Weld Fittings

That's right, W-S emphasizes the *plural* when it comes to the various steels for forged fittings.

From Monel down to the full range of carbon types, including low sulphur and phosphor-controlled grades, W-S *forged* fittings spark the trend toward specialized materials for specialized needs.

What's *your* problem? STRENGTH? W-S is a leading supplier to the high-pressure, high-temperature power industry. CORROSION? W-S stainless and alloy fittings tie America's main arteries of chemical production. SANITATION? W-S is a big producer of the popular Type-304 for food and pharmaceutical operations. Low temperature? Another W-S specialty.

And there's one problem common to all . . . COST. Let us show you how W-S *forged* fittings provide the lowest *service* cost obtainable.

9-M-2

• Stronger • Smaller • Lighter • Tighter
• More Uniform • Lower *Service* Cost

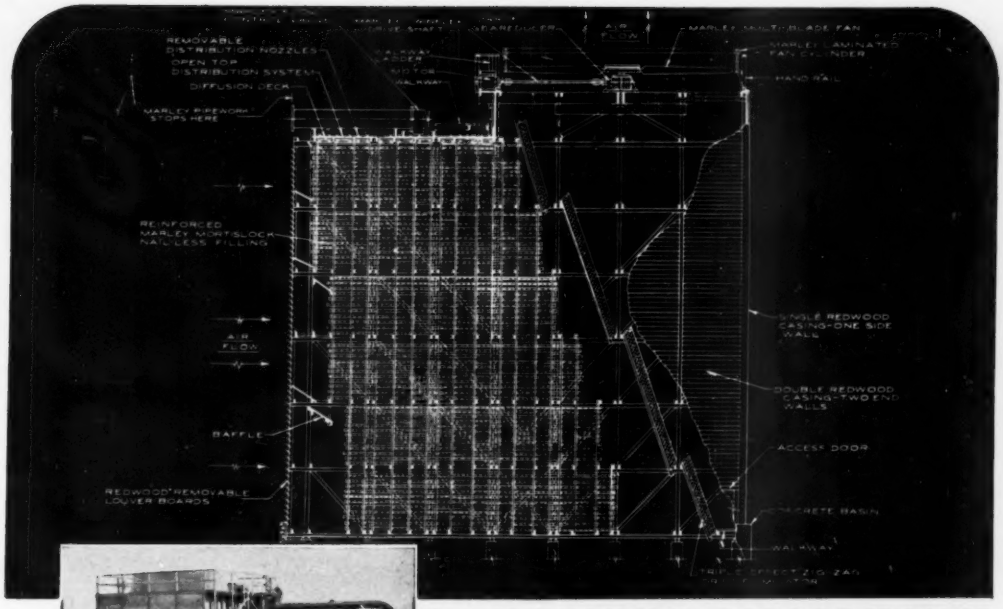
SOLD THROUGH LEADING DISTRIBUTORS . . . EVERYWHERE

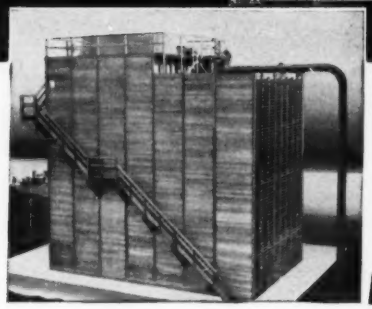
WATSON-STILLMAN
ESTABLISHED 1848

DISTRIBUTOR PRODUCTS DIVISION

ROSELLE, NEW JERSEY

Designers and Manufacturers of Forged Steel Fittings, Wire Rope Shears, Hand Pumps, Jacks, Pipe Benders and Hydraulic Equipment





for MAXIMUM PERFORMANCE with NARROW PLAN AREA

Engineers who know, choose MARLEY Single-Flow

SINGLE-FLOW COOLING TOWERS adapt Marley patented cross-flow water cooling to confined areas, retaining the features that have built and maintained Marley leadership in industrial water cooling.

Some of these design features, such as the full-height louvered end-wall and patented Mortis-Locked filling are most fully utilized in Single-Flow design. That means greater air volume, more breakup, longer air-water contact—it means wide cooling range and close approach to wet bulb temperature.

Open, visible distribution with its many operational advantages is included in Single-Flow engineering. All mechanical equipment is Marley designed and Marley manufactured for cooling tower use exclusively.

The rugged structural strength and long-tested durability that characterize all Marley design are engineered into every Single-Flow tower. Ease of maintenance and safety of operation are functional features of these high performance towers.

Marley Application Engineers, located in fifty leading cities, will gladly give you further information on Single-Flow cooling towers.

producers of

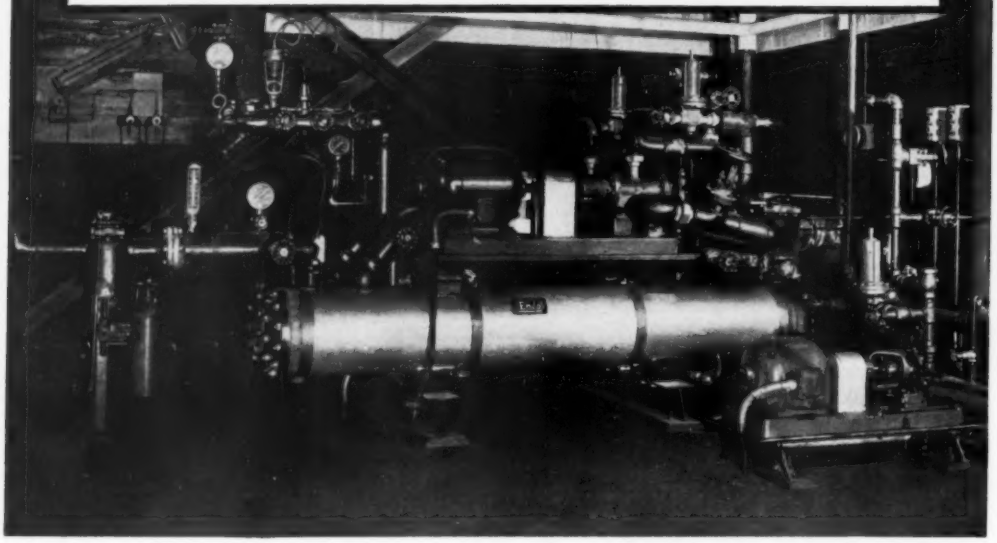
DOUBLE-FLOW TOWERS
AQUATOWERS
DOUBLE-FLOW AQUATOWERS
DRICOOLERS
NATURAL DRAFT TOWERS
CONVENTIONAL TOWERS
SPRAY NOZZLES

MARLEY

The Marley Company, Inc.

KANSAS CITY 5, MISSOURI

2 separate ENCO Fuel Oil Units Meet Plant Needs



Here is a typical Enco two-unit installation which handles fuel oil pumping and heating requirements in the plant of a building materials manufacturer.

Fuel Oil Pumping and Heating Unit, built with two pumps and two heaters, is designed for continuous plant load service. Capacity is 11 gpm Bunker C fuel oil with one pump or one heater at 300 psig pressure with a temperature rise from 90F to 230F.

Light Oil Pumping Unit for cold start-up service. Capacity is 3 gpm #2 oil at 300 psig pressure.

Enco pump sets are designed to give you easier control and longer maintenance-free operation. They are simple and economical to install. All you need do is to connect to station piping and run. Before shipping, every Enco Fuel Oil Pumping and Heating Unit is completely tested under high pressures. For complete details on wide-range line, write for Bulletin O B -37.

Only ENCO offers all ten plus features

1. Completely Automatic Operation is assured by automatic temperature and pressure regulation valves.

2. Coordinated Design Saves Space. All equipment essential to the preparation of fuel oil for combustion is contained in one compact unit.

3. Individually Designed to meet the specific needs of the particular power plant in accordance with its exact operating requirements.

4. All Parts Visible and Accessible for easy operation, maintenance and repair.

5. Pumps and Heaters are interconnected to provide maximum flexibility of operation.

6. Safety Valves protect individual parts where required.

7. Easier Maintenance — Less Service-Time for Cleaning because straight tube, multi-pass heaters with removable heads are used.

8. Pumps Operate at Moderate Speed. Heaters designed to give the correct viscosity and velocity without fouling.

9. Smoother Flow of Clean Fuel to Furnace. Air chamber for each piston pump prevents pulsations—pressure regulator for rotary pumps. Twin type strainers provided to keep atomizer tips from clogging.

10. Cleaner Boiler Room . . . all overflows connected to a common outlet, flanged drip pan catches oil drip.

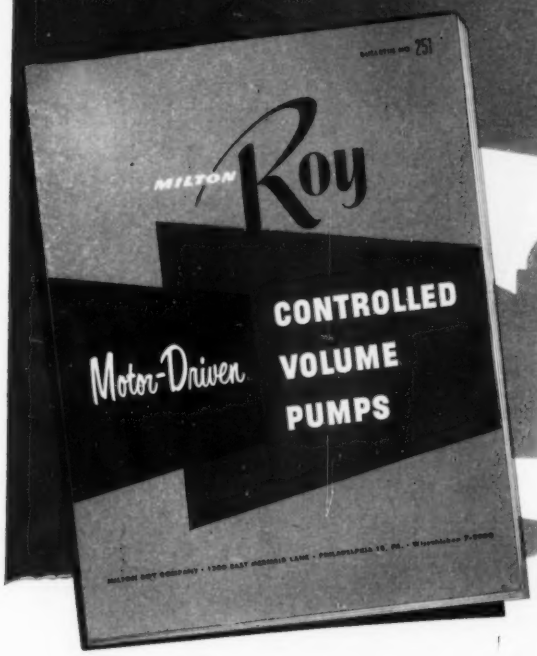
EC 485

THE ENGINEER COMPANY

75 WEST STREET, NEW YORK 6, N. Y.

IN CANADA: F. J. RASKIN, LTD., 4320 IBERVILLE ST., MONTREAL 34, P. Q.

Motor-Driven CONTROLLED VOLUME PUMPS



Complete Information In These Pages

What *are* Milton Roy Motor-Driven Controlled Volume Pumps? What materials do they pump? How and where are they used? What different designs and models are available?

The answers to these questions and many more can be found in Bulletin No. 251. This illustrated, 24-page, 2-color bulletin is full of important details. Here is a preview of some of the subjects which are discussed:

- a description of various Milton Roy Motor-Driven Controlled Volume Pumps—the Simplex, Duplex, Constametric, "Titronic," and "miniPump."
- an explanation of the exclusive Milton Roy Liquid End Step-Valve design. This information is useful because it describes the "how" and "why" of this unique non-clogging, self-cleaning liquid end.
- a description of pump capacity regulation by *plunger stroke* adjustment, including screw adjustment, micro adjustment, motorized micro adjustment.
- details on pump capacity regulation by *plunger speed* adjustment, including speedranger adjustment, "Thymotrol" adjustment, Link Belt P.I.V. adjustment.
- data on where Milton Roy Motor-Driven Controlled Volume Pumps can be used.
- capacity-pressure selection tables are included.

If your operations call for pumping liquids in accurately measured volume in amounts as low as 3 milliliters per hour or as high as 50 gallons per minute, we're sure Bulletin No. 251 will be of value to you. For your free copy, write the Milton Roy representative listed in your local classified telephone directory. Or, write directly to us.

Manufacturing Engineers

WITH THE EXCLUSIVE STEP-VALVE DESIGN

MILTON Roy COMPANY

1320 EAST MERMAID LANE, PHILADELPHIA 18, PA.

CONTROLLED VOLUME PUMPS AND AUTOMATIC CHEMICAL FEED SYSTEMS

IT'S PACKED
WITH SATISFACTION
WHEN IT'S PACKED
WITH **R/M**

In high-pressure compressors like this, and under all kinds of difficult operating conditions, Raybestos-Manhattan Packings and Gaskets will give long, trouble-free service. R/M Packings are made for high pressures, high temperatures, and extreme low temperatures, as well as for service against caustics, acids, gas, water, steam, petroleum and other commercial fluids. Your R/M distributor can help you select the right packings for your plant. Call him today.

R M **PACKINGS**

RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, MANHEIM, PA.

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Crawfordsville, Ind.; Passaic, N.J.; Peterborough, Ontario, Canada

RAYBESTOS-MANHATTAN, INC., Manufacturers of Packings • Asbestos Textiles • Industrial Rubber Products • Abrasive and Diamond Wheels • Rubber Covered Equipment • Brake Linings • Brake Blocks • Clutch Facings • Fan Belts • Radiator Hose • Sintered Metal Products • Bowling Balls

clarify wastes at least cost...

the Cyclator®

meets disposal requirements best...

1 Because the Cyclator combines recirculation for more complete clarification and faster settling with mechanical thickening for maximum sludge compaction... you gain greatest B.O.D., oil and suspended solids reduction at considerably higher flow rates than in "old style" disposal plants.

2 Because the Cyclator increases purification rates and eliminates the need for large chemical mixing, coagulating and settling basins, you save space... save on first costs.

3 Case histories of Cyclator operation dramatically

(continue to next page)

INFILCO
since 1894

(continued from preceding page)

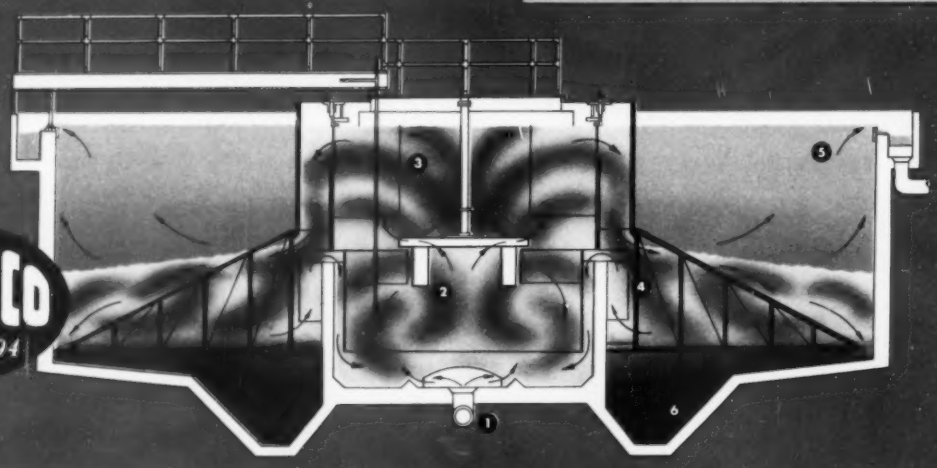
illustrate the vital point that the Cyclator will clarify wastes to your local requirements at least cost. Write for Bulletin 850A – containing data and case histories which show how the Cyclator exceeds expectations for processors everywhere – North America, South America, Europe.

INFILCO INC. ★ *Tucson, Arizona*

Here's how the Cyclator EXCEEDS waste disposal requirements

- ★ Space-savings up to 80% in comparison to "old-style" treatment plants.
- ★ By-product recovery and water re-use pay for Cyclator operation in many cases.
- ★ Removes suspended and colloidal solids, oils and toxic compounds rapidly and efficiently.
- ★ Throughput is extremely high because chemical feeding, recirculation and mechanical thickening are perfectly balanced in a single basin.
- ★ Reduces chemical costs because most efficient mixing is attained with recirculation.
- ★ Effluent purified to the degree required to meet pollution control regulations.

INFILCO since 1894



"EXPLAIN-MORE" DIAGRAM

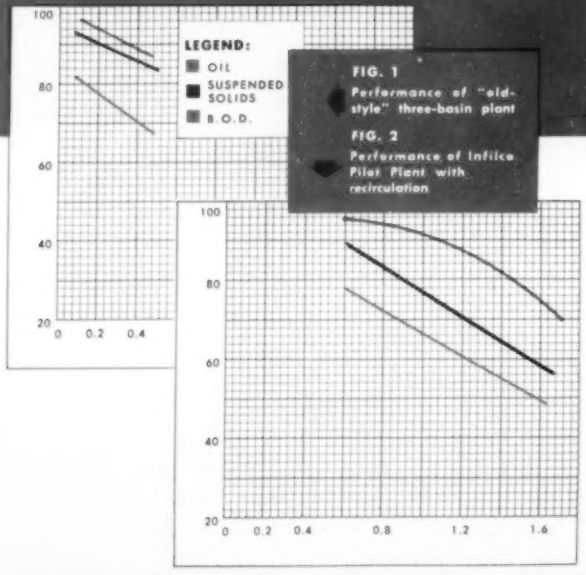


FIG. 1 Performance of "old-style" three-basin plant

FIG. 2 Performance of Infilco Pilot Plant with recirculation

TAKE A LOOK AT PROCESS SAVINGS—

Here's a recent pilot plant study. An Infilco pilot plant was installed in parallel with a treatment plant with separate mixing, flocculating and sedimentation basins.

Both plants treated oil-bearing wastes. Alum and activated silica were used as the coagulants. Figure 1 shows that the three-basin plant operated at a rise rate of only 0.2 gpm per square foot for about 95% oil removal. Slightly higher removal was gained with the Infilco plant and at a rise rate of 0.6 gpm!

The result: two 100-foot diameter Cyclators were installed by a large Eastern refinery to treat waste at 3700 gpm. Process savings like this are typical of Cyclator installations. When you need facts for waste disposal at least cost, ask for Infilco's specialized experience . . . there's no obligation for preliminary planning.

Combined for Service and Savings:

AUTOMATIC CONTROL

and INSTRUMENTATION

by HAGAN

Hagan Engineers have developed automatic control equipment and instruments which can be assembled into coordinated systems designed to meet your particular requirements. For example:

HAGAN AIR-OPERATED AUTOMATIC CONTROL EQUIPMENT includes pressure measuring and control units which may be combined into automatic control systems for process industries, metallurgical furnaces and steam power plants.

HAGAN THRUSTORQ is designed to measure forces and transmit a proportional signal to actuate a recording or indicating instrument, or an automatic control system. Typical applications include: automatic batch weighing, rocket thrust measurement, dynamometer testing of electric motors and internal combustion engines.

HAGAN RING BALANCE FLOW METERS are the most versatile meters available. Hagan Meters indicate, record, and integrate one or two flow rates. Standard modifications provide for pressure and temperature compensation. Ring assemblies are available to measure pressure differentials from 20" to 140" WC at static pressures up to 15,000 psig, and from 40" to 420" WC at static pressures to 2000 psig.

WRITE, WIRE or PHONE today for information about how Hagan Engineers can help you solve your industrial control and instrumentation problems.

HAGAN CORPORATION

HAGAN BUILDING
PITTSBURGH 30, PENNSYLVANIA

RING BALANCE FLOW AND PRESSURE INSTRUMENTS
THRUSTORQ FORCE MEASURING DEVICES
BOILER COMBUSTION CONTROL SYSTEMS
METALLURGICAL FURNACE CONTROL SYSTEMS

HAGAN
HALL
BUROMIN
CALGON

Meeting a tight

New York's largest

STEAM GENERATOR

a 1,450,000 lb per hr FOSTER WHEELER

New York is perennially "bursting at the seams"—but there is always a way to accommodate additional development. This is made possible by wise city planning and the far-sighted policy of the Consolidated Edison Company of New York, Inc. which keeps ahead of New York's ever-growing demand for electricity. The new Foster Wheeler Steam Generator now being constructed for the East River Station of the Consolidated Edison Company is a contemporary example of how one organization seeks to anticipate the needs of future populations.

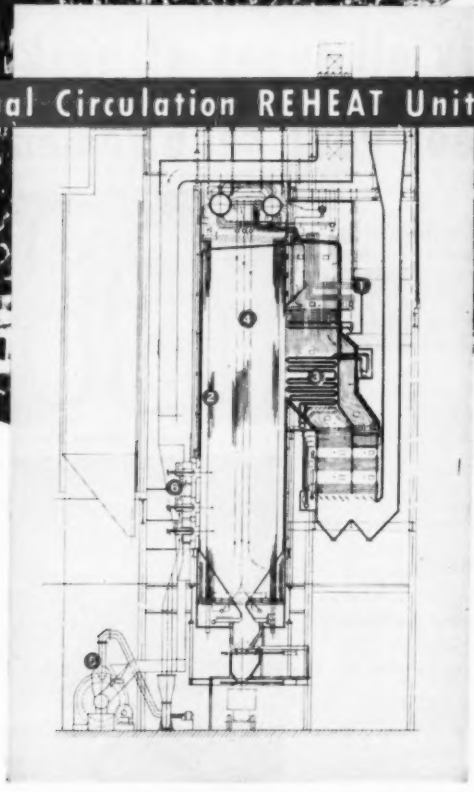
FOSTER WHEELER CORPORATION • 165

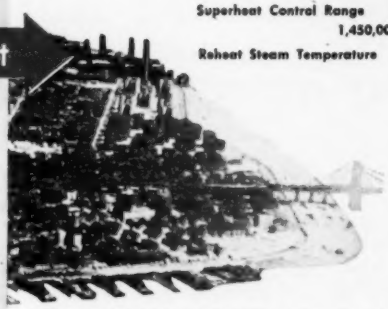
situation

New FW Steam Generator for the East River Station of the Consolidated Edison Company of New York, Inc.

Maximum Capability	1,450,000 lb per hr
Pressure Superheater Outlet	1850 psig
Primary Steam Temperature	1000 F
Superheat Control Range	325,000 to 1,450,000 lb per hr
Reheat Steam Temperature	1000 F

Dual Circulation REHEAT Unit





1. **STEAM OF SUPER PURITY**—Application of dual circulation principle produces steam of lowest contamination especially silica.
2. **RADIANT SUPERHEATER**—in combination with convection superheater enables attainment of full primary steam temperature from 25% to full load.
3. **CONVECTION REHEATER**—Location in low temperature zone after convection superheater provides protection against all variables in operation.
4. **CONSERVATIVE FURNACE**—Low heat absorption rates per unit area and low furnace exit gas temperatures.
5. **FOSTER WHEELER BALL MILLS**—High availability, low maintenance and sustained fineness of pulverization.
6. **FOSTER WHEELER TURBULENT BURNERS**—Turbulent action of air and fuel produces uniform mixture for complete combustion and even heat distribution.

BROADWAY, NEW YORK 6, N. Y.

FOSTER WHEELER

1 gasket or 1,000,000

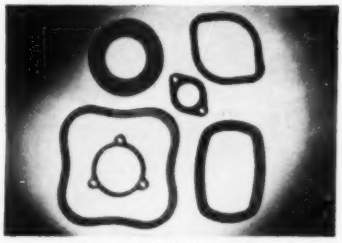
GARLOCK can supply all types of gaskets in *any* quantity to meet your requirements.

GARLOCK has the facilities to die cut, hand cut, mold, or machine all sizes and shapes of gaskets in *any quantity*. Yes, whether you are a small or big user, Garlock can supply you with the proper gaskets made accurately to your blueprint specifications or template.

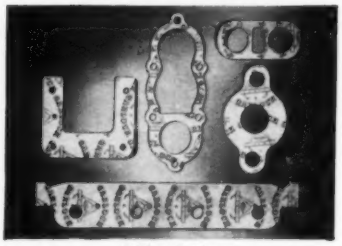
There's a Garlock gasket that answers your every requirement efficiently and economically. Some of the most widely used Garlock gasketing materials are:

- Compressed Asbestos with rubber, neoprene or buna- N binder
- Woven Asbestos
- Rubber—plain, cloth inserted or wire inserted
- Neoprene—plain or cloth inserted
- Buna-N
- Thiokol—plain or cloth inserted
- Silicone—plain or cloth inserted
- "Teflon"
- Vegetable Fibre
- Cork-Fibre
- Asbestos—metallic
- Leather

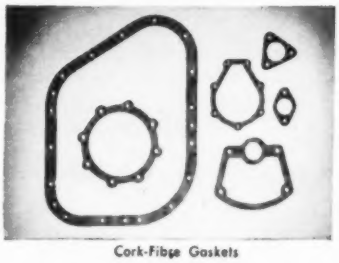
Let your Garlock representative help you solve your gasketing problems—call him today.



Compressed Asbestos Gaskets



Rubber Gaskets

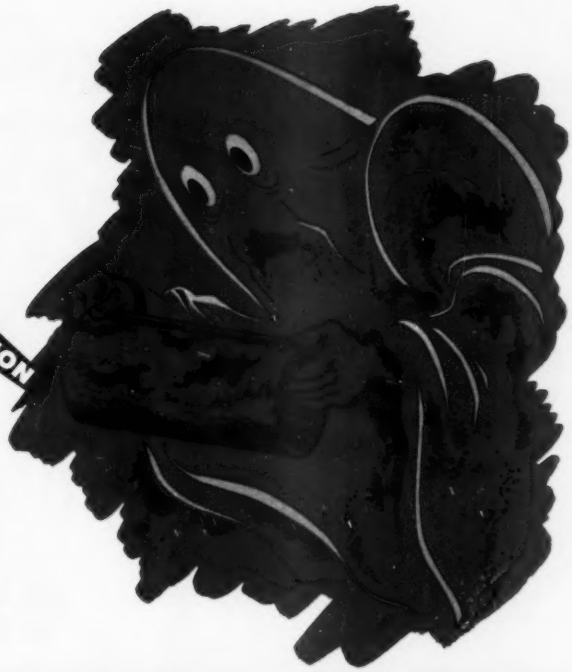


Cork-Fibre Gaskets

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK

DRAW A BEAD ON BOILER CORROSION



CORROSION which results from chemical or electrochemical reaction between a metal and its environment may lead to serious loss of metal, to fracture and to deposits. Corrosion deposits are usually precipitated on or near the corroded area. In certain instances, however, they may be deposited a considerable distance from the point at which the metal is undergoing attack . . . *(Ref. ASTM D 1129-51).*

Use DREW POWER CHEMICALS

Corrosion may be active in your boiler water system now—ready to cause expensive trouble in boilers, steam and condensate lines. Serious deposits may result from corrosion. It's time now to inspect your boiler system thoroughly, to avoid inconvenience—even plant shutdown.

So, draw a bead on boiler system corrosion, Mr. Engineer. Call for the Drew Power Chemicals Engineer. The water samples and operating data he obtains in your plant will be thoroughly analyzed in the Drew Laboratories. You'll be given specific recommendations for corrective or preventive treatment. Furthermore, your Drew Engineer will give you frequent and continuous help in your plant.

Thorough investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Consult the nearest Drew Engineer, or write for information.

Power Chemicals Division

E. F. DREW & CO., INC.

15 East 26th Street, New York 10, N. Y.

AJAX, ONTARIO

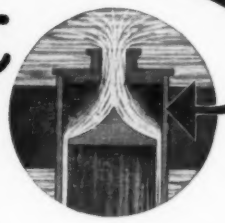
SAN FRANCISCO CHICAGO PHILADELPHIA BOSTON DALLAS

Service throughout the United States, Canada and South America

DREW PRODUCTS

Dirty Water can't "Shut-down"...

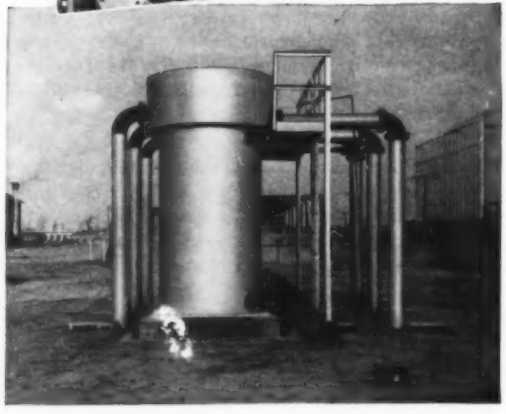
Vogt



film type exchangers

(Condensers—Coolers—Evaporators)

Patent Nos. 1,935,270 - 2,057,597 - 2,424,441



River water, well water or brackish water are all alike to this exchanger *because it can be cleaned* while in operation! The water distributing ferrules need only be removed successively for the cleaning brush or tool whereby the tubes receive additional water which sluices away the dislodged dirt.

Vogt Film Type Exchangers are operating with real economy of first cost, operation and maintenance in power, petroleum, and chemical industries. They serve as Jacket Water Coolers, Feed Water Heaters, Hydrocarbon Evaporators, Sulphuric Acid Coolers, and Sulphur Dioxide Condensers, and can be designed to cool or heat any liquid and to condense or evaporate any fluid.

TOP: *Four units at Newton Falls, Ohio Municipal plant cool water for diesel engines and a lubricating oil cooler.*

BOTTOM: *Jacket Water Coolers serving engines of 7,300 HP in the compression plant of a Western Oil Refinery.*

[Bulletin HE-7 describes typical installations of Vogt Film Type exchangers and is available upon request.]

HENRY VOGT MACHINE CO., LOUISVILLE, KY.

Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

"Major utilities now grant complete acceptance to inhibited turbine oils"

. . . and here's why so many of them choose **SHELL TURBO OIL**

Shell Turbo Oil exceeds every accepted specification for premium turbine lubricants. These are the notable qualities:

1. HIGHEST ATTAINABLE RUST PROTECTION

An effective *combination* of rust inhibiting additives goes to work at the source of rust formation. Rust problems are reduced to the very lowest level.

2. COMPLETE OXIDATION STABILITY

The anti-oxidant in Shell Turbo Oil has so far defied improvement! It provides outstanding oxidation stability and thereby minimizes sludge formation.

3. ANTI-FOAMING

The anti-foam agent now used is so effective that air entrainment can be tolerated for considerable periods . . . avoiding unscheduled shutdowns.

4. EXCELLENT EMULSION CHARACTERISTICS

Shell Turbo Oil's remarkable protection against rust and oxidation is attained with the minimum tendency to formation of water emulsions in service.

5. PROTECTION AGAINST WEAR

The inhibitive agents in Shell Turbo Oil *add* to the wear-reducing qualities of the specially refined oil itself, an extra margin of safety for the bearings during critical starting period.

For additional information on Shell Turbo Oil mail coupon.

SHELL TURBO OIL

SHELL

SHELL OIL COMPANY
50 West 50th Street, New York 20, N. Y.
or 100 Bush Street, San Francisco 6, Cal.

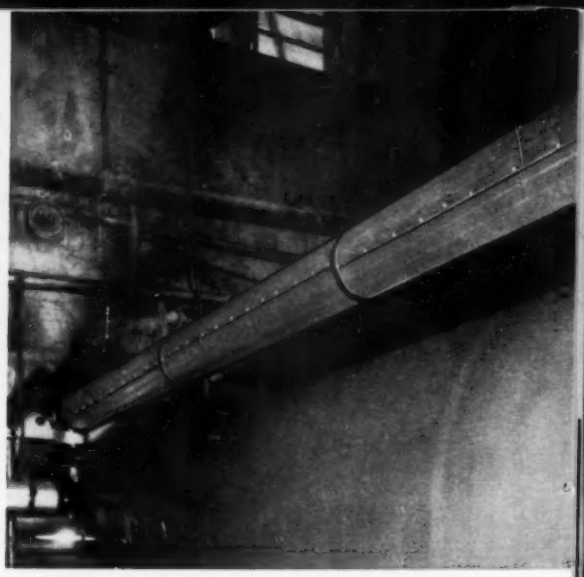
Please send information on Shell Turbo Oil.

Name_____

Company_____

Address_____

IN PETROLEUM REFINERIES like this a new kind of aluminum jacketing is used to protect the insulation on hot and cold lines. It is known as Childers Aluminum Jacketing and is especially engineered to combine the long life and weather resistance of aluminum with a low first cost. It goes on quick and easy—can be used and re-used. It is made of tough but flexible .006" 35 aluminum alloy, so it handles easily and requires no shop forming.

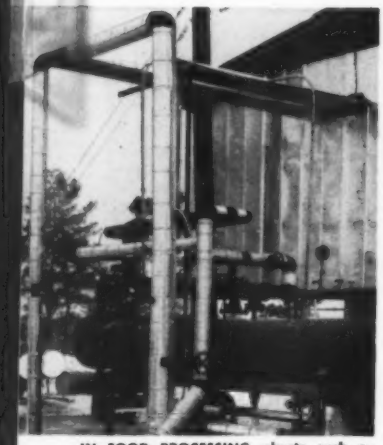


IN CHEMICAL AND PAPER plants: engineers are finding new uses for this easy-to-handle jacketing. Childers Jacketing here is in use at Scott Paper Company's tremendous Chester, Pa., plant. The insulated line passes between fast moving rolls carrying the felt used in paper making both above and below the line. The Aluminum Jacketing protects against paper dust and water, both of which are always present in the manufacture of paper. The jacketing also appreciably diminishes the possibility of the spread of fire which might strike across ordinary canvas jacketing.

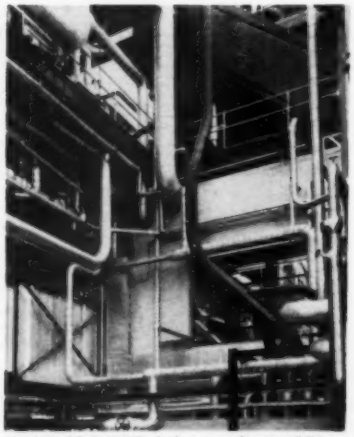
Engineered for outdoor lines — new, low-cost aluminum jacketing now used in 567 processing plants

The new kind of aluminum jacketing for insulated lines shown in the pictures on this page is Childers Aluminum Weatherproof Jacketing. Write for samples and full details, no obligation. Childers Manufacturing Co., Dept. PE-3, 3620 W. 11th St., Houston 8, Texas.

Under CMP regulations, Childers is a Class B product, the use of which is not restricted.



IN FOOD PROCESSING plants such as this Minute Maid Corp. unit at Plymouth, Fla., Childers Jacketing is useful for both indoor and outdoor installations. Its clean, shining appearance and ease of washing are extra advantages.



IN POWER PLANTS—indoors and out—Childers Jacketing is an ideal material for protecting insulation. This is a big outdoor installation in the South. This jacketing needs no painting, and the gleaming aluminum surface makes for "good housekeeping" in any utility or institutional power station.

ALMOST ANYWHERE you have insulated lines in your processing plant, consider this specially engineered jacketing. It is flexible, easy-to-handle; yet it has the appearance values and the weather resistance that are inherent in aluminum. Write to address shown above for full details.

And valuable man-hours are LOST by old style steam trap piping

Whether man-hours are lost by accidents or old style steam trap piping, they are costly. That's why hundreds of manufacturing plants are switching to Super-Silvertop* Steam Traps. The better design of these traps eliminates jungle piping. Three pipe connections in the head saves up to 50 minutes installation time and as many as 7 fittings. Since Super-Silvertops can be serviced without removing the trap from the line, 30 minutes time can be saved whenever you inspect, clean or service your trap. Because Super-Silvertop valve and seats are made of longer lasting Anderloy* and because the bucket is guided on a center tube eliminating bucket damage, trap failures and replacements are few and far between.

Don't be troubled with frequent servicing of steam traps. Don't waste precious man-hours. Send for your copy of "Solving Steam Trap Problems" today and see how Anderson Super-Silvertop Steam Traps reduce LOST MAN-HOURS.

*T. M. Reg. in U. S. Pat. Off

SUPER-SILVERTOPS SAVE MONEY

THE V. D. ANDERSON COMPANY
1977 West 96th Street • Cleveland 2, Ohio

Gentlemen:
Please send without obligation "Solving Steam Trap Problems."

Name .....

Address .....

City ..... State .....

In Canada: Bawden Industries, Ltd. Toronto

B&W Research and Development Come ...

modern trends in steam generation that are helping to keep power

COSTS

——— down

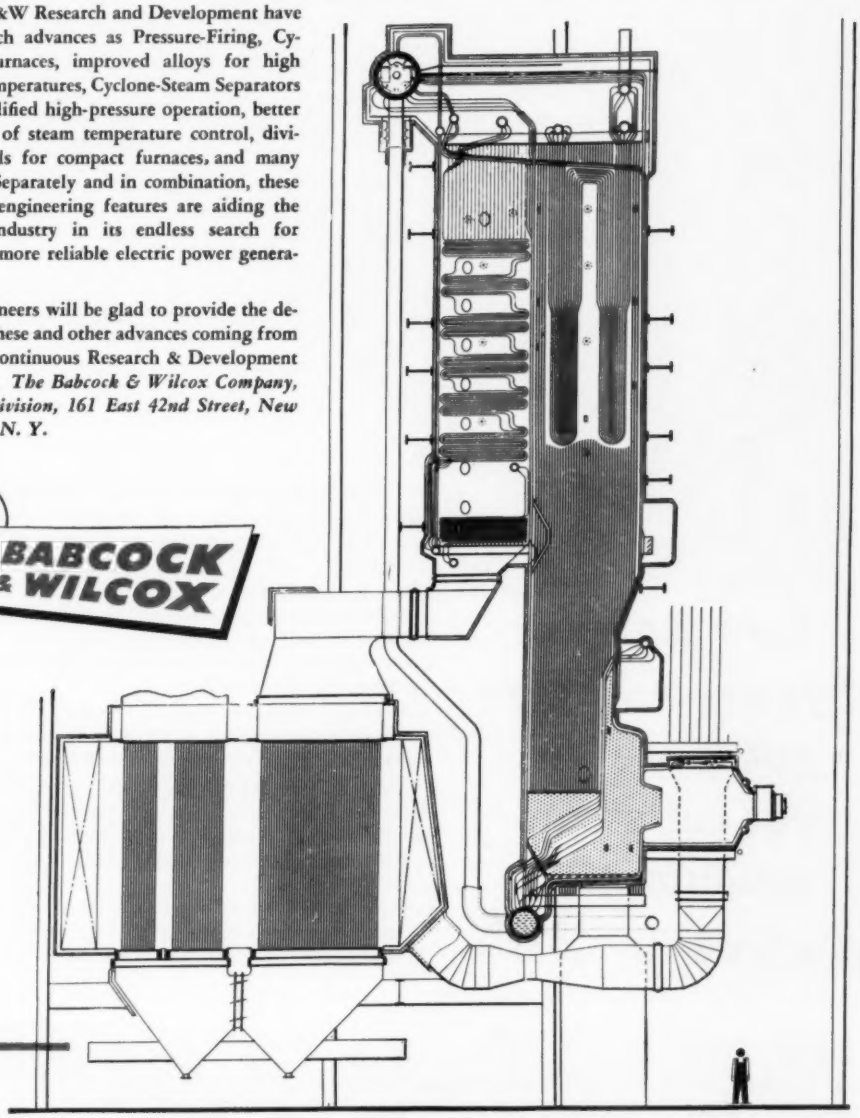
G-562T

In averaging 1.13 lb. of coal per kilowatt-hour during the past year, America's electric companies set a new record in their uninterrupted drive to hold down the cost of electric power generation. This continued, phenomenal, year-by-year record of progress has resulted from painstaking attention to the details of *all* equipment needed for the production of electricity. Of particular significance have been B&W developments in fuel-burning methods and steam generation. Many of these are included in today's most efficient stations having heat rates of less than 0.8 lb. of coal per kilowatt-hour.

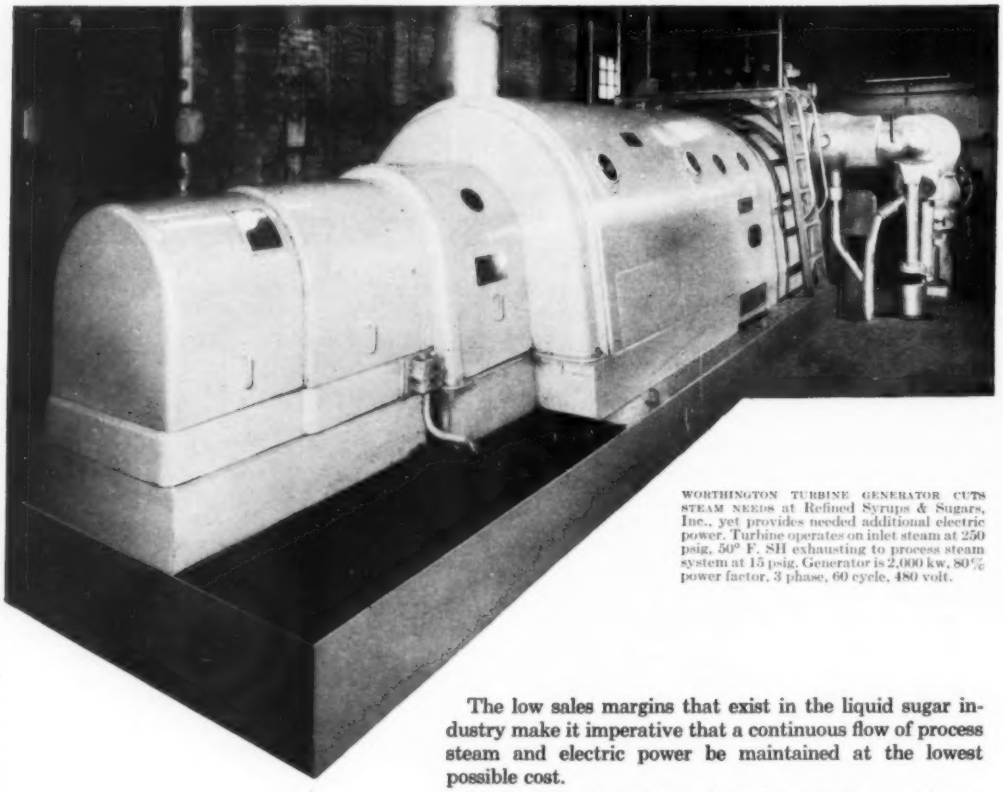
From B&W Research and Development have come such advances as Pressure-Firing, Cyclone Furnaces, improved alloys for high steam temperatures, Cyclone-Steam Separators for simplified high-pressure operation, better methods of steam temperature control, division walls for compact furnaces, and many others. Separately and in combination, these modern engineering features are aiding the power industry in its endless search for cheaper, more reliable electric power generation.

Our engineers will be glad to provide the details on these and other advances coming from B&W's continuous Research & Development Program. ***The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.***

BABCOCK & WILCOX



Pressure-Firing, Gas Recirculation, Cyclone Furnaces, High Pressure and Temperature with Reheat, and Cyclone Steam Separators are features of this B&W Radiant Boiler on order for a mid-west power company. Rated steam capacity—1,200,000 lb. per hr. Design pressure—2125 psi. Pressure at superheater outlet—1900 psi. Final steam temperature—1050F. Reheat to 1000F.



WORTHINGTON TURBINE GENERATOR CUTS STEAM NEEDS at Refined Syrups & Sugars, Inc., yet provides needed additional electric power. Turbine operates on inlet steam at 250 psig, 50° F. SH exhausting to process steam system at 15 psig. Generator is 2,000 kw, 80% power factor, 3 phase, 60 cycle, 480 volt.

How Refined Syrups & Sugars got more kw, yet cut steam consumption per kwh by 29%

The low sales margins that exist in the liquid sugar industry make it imperative that a continuous flow of process steam and electric power be maintained at the lowest possible cost.

It was with this fact in mind, and a need for more electric power at economical rates, that Refined Syrups & Sugars of Yonkers, New York, replaced existing steam drives with electric motors and installed a modern Worthington 2,000-kw steam turbine generator.

Not only did this arrangement meet the need for added power requirements, but also reduced the amount of steam consumed in generation of power by 29% per kwh.

By going "Worthington", Refined Syrups & Sugars—like the many other Worthington users—found that unit responsibility has its rewards. Each Worthington turbine generator is designed, assembled and tested *as a complete unit* before shipment.

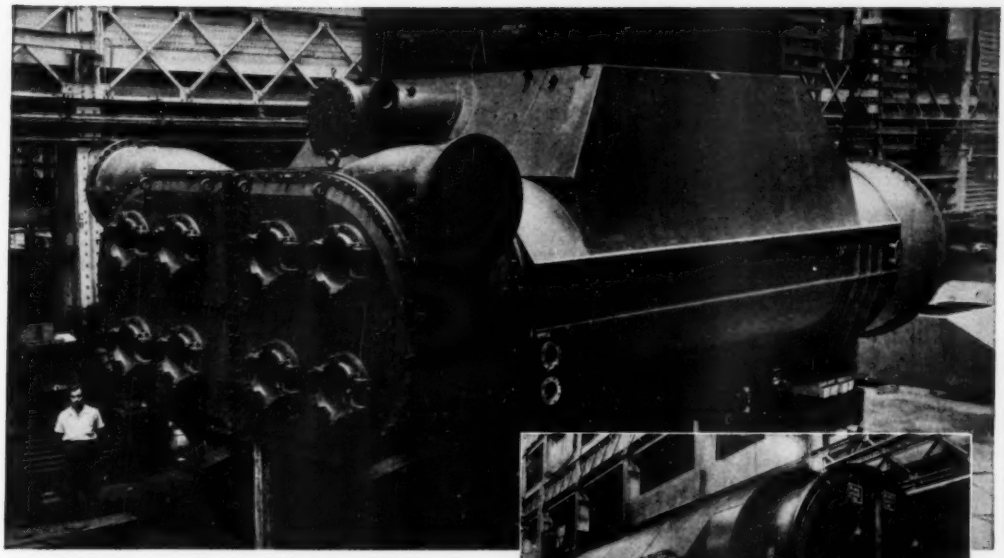
Sizes to 10,000 kw. Worthington Corporation, formerly Worthington Pump & Machinery Corporation, Steam Turbine Division, Wellsville, New York.

T-2.17

A GREAT TEAM IN STEAM

WORTHINGTON

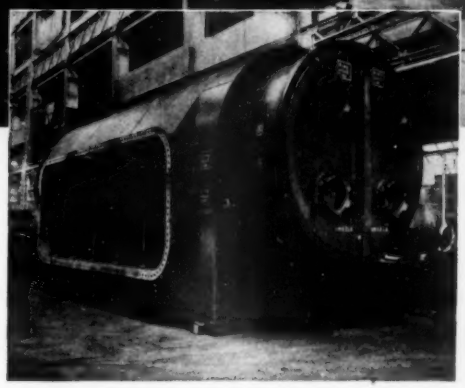
Steam Turbine Generators



LOW-HEADROOM, OVAL-TYPE CONDENSER (with extraction heater in exhaust neck), is typical of several furnished in sizes ranging from 27,500 to 80,000 sq. ft.

"TAILORED TO FIT"

Low-headroom design for condensers typical of Worthington "space" engineering



SIDE INLET CONDENSER, one-half of several "twin shell" units serving turbine-generators of 20,000 to 100,000 kw

It all began in 1854.

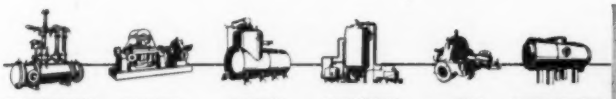
That was the year the first Worthington condenser was installed. From that time, up through the early twentieth-century "evolutionary" period in condenser design, Worthington has constantly kept in step with prime mover and steam power plant development. Today, engineers must design and build condensers within the limitations imposed by high construction costs.

Thanks to the flexible nature of the Worthington "Double Folded Tube Layer", today's "low-headroom" requirements are easily met without any sacrifice in efficiency. For single-shell, beneath-turbine installations, the rectangular box-type (built by Worthington as early as 1904) has given way to the modern "oval" design illustrated above. Other designs include single-shell, side-mounted units with exhaust elbows, and twin shells with horizontal or "T" shaped exhaust connections, popular for outdoor or semi-outdoor plants.

As the capacity of turbine-generators increases, so does the demand for larger condensers. This places more importance on "space" engineering. Worthington—with over a century of experience in the manufacture of steam power equipment—is prepared to build efficient condensers in all sizes to suit any reasonable limitations. (Now under construction for an eastern utility is the largest single-shell unit ever ordered—125,000 sq. ft.)

Write for advice on your new installation, stating requirements. Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

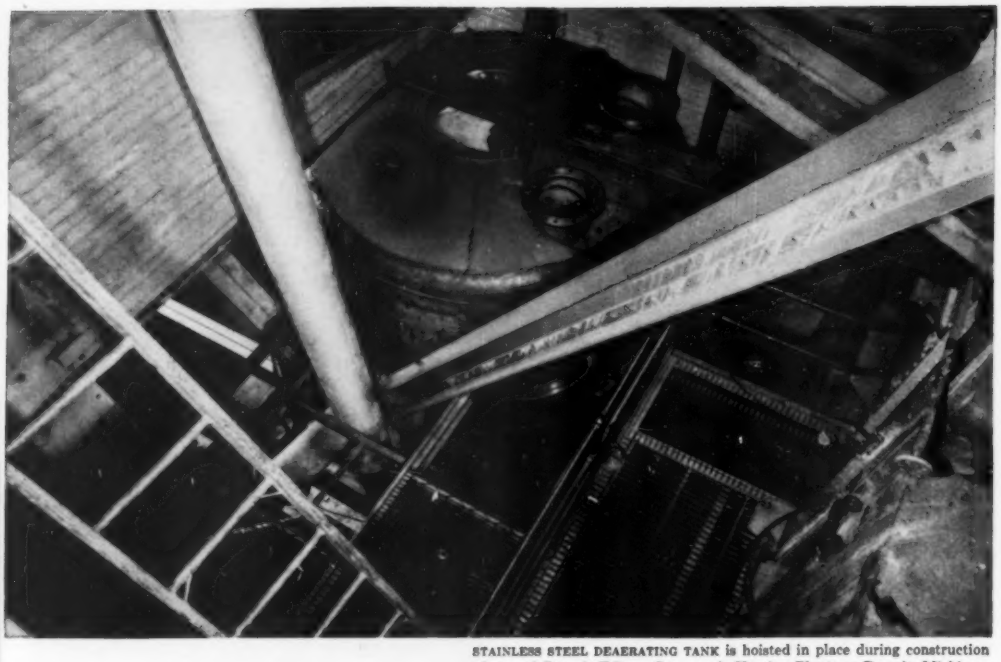
Z-2.1



A GREAT TEAM IN STEAM

WORTHINGTON

Condensers



STAINLESS STEEL DEAERATING TANK is hoisted in place during construction of one of Detroit Edison Company's Heating Plants at Detroit, Michigan.

When CO_2 Caused a Headache ...Worthington Cured It

Detroit Edison had the solution to its problem—the problem of CO_2 in its steam—except for one thing.

Zeolite-softened municipal water used in their steam plant contains high percentages of carbonates which decompose and generate CO_2 in the boilers. Carried over with the steam into heating and processing equipment, that CO_2 could cause plenty of trouble.

The CO_2 problem was solved by Detroit Edison engineers by acid treating the softened water, converting the carbonates to CO_2. The gas thus formed is driven off in a deaerator.

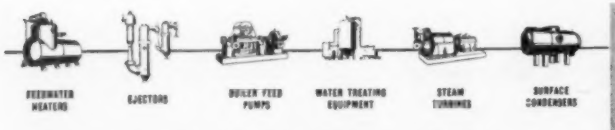
However, no standard deaerator could successfully remove the large quantities of CO_2 released by the acid treatment, and deliver water to the boiler with practically zero oxygen and zero CO_2. Furthermore, standard materials would have lasted only a few months under such conditions.

NON-CONTAMINATED STEAM

Worthington provided the answer. Detroit Edison engineers selected a Worthington deaerator specially designed for these severe conditions, built entirely of stainless steel, and guaranteed to deliver water containing not over 0.005 ppm of oxygen and not over 0.1 ppm of CO_2. The result is steam containing so little CO_2 that the amount *cannot be accurately measured!*

On problems like this one, Worthington not only furnishes *all* of the equipment needed in a complete water treating installation, but also has the engineering ability to work with your engineers on the *complete* problem of generating steam for power or processing. For further information on why *there's more worth in Worthington*, address Worthington Corporation, formerly Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, New Jersey.

5.1.2



A GREAT TEAM IN STEAM

WORTHINGTON

Feedwater Heaters

Leading utilities specify

USKORONA

because it's the tape that will not break down

USKORONA SPLICING COMPOUND
¾ IN. WIDE
US
30 FT. ROLL
OZONE AND MOISTURE RESISTING COMPOUND
Uskorona combines maximum resistance to OZONE and MOISTURE with high tensile strength, elongation and dielectric resistance. Fuses quickly without heat or pressure and makes PERFECT SPLICES.
MADE IN U.S.A.
United States Rubber Company

LET US SEND YOU A SAMPLE

U.S. RUBBER
SERVING THROUGH SCIENCE

U.S. Uskorona was the only tape of 4 leading brands that was still intact after a 4-hour corona-(ozone) resistance test. All others broke down.

Even after 500 additional hours of consecutive exposure, Uskorona remained as fresh and corona-resistant as at the start.

More amazing still, Uskorona is the only tape that is resistant to both corona and moisture.

No wonder many a leading power company has made Uskorona standard for underground splices, joints and connections. It is thoroughly effective on single or multiple cable, on secondary network systems, street lighting circuits and transformer leads.

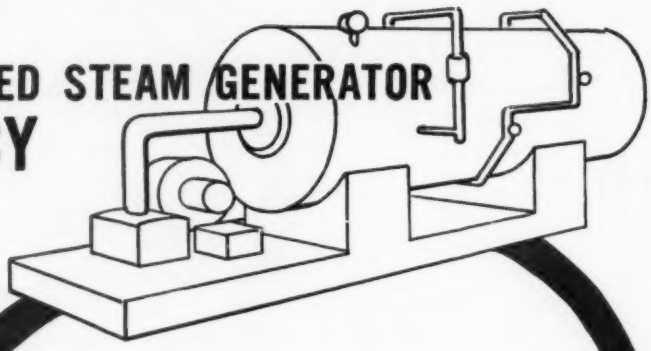
For more data on moisture- and corona-resistant Uskorona, write to address below.

UNITED STATES RUBBER COMPANY

TAPE DEPARTMENT • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Ideal Combination

FOR TOP SELF-CONTAINED STEAM GENERATOR EFFICIENCY



1

Nalco WATER TREATMENT
SCALE AND CORROSION PREVENTION

With a Nalco Service Policy and Nalco Chemicals to fit your water treatment requirements, you can keep your self-contained boilers operating indefinitely at top efficiency — without any of the costly difficulties caused by scale and corrosion. This part of the Nalco System was designed expressly to provide small boiler users with the same complete water treatment services enjoyed by thousands of the country's largest power plants. A new 4-page bulletin gives complete details on The Nalco System as applied to the modern self-contained boiler. Your copy will be sent promptly, without obligation.

Write for Bulletin 49

2

Nalco SR-155 FUEL OIL ADDITIVE
FUEL SAVING... CLEAN BURNERS

Nalco SR-155 is a *complete* fuel oil additive. It replaces two, three or more single-purpose additives to: (1) keep storage tanks, fuel lines and burners free of sludge and gum; (2) prevent soot formation in the firebox and flues; (3) inhibit corrosion throughout the fuel system; and (4) act as a combustion catalyst to assure complete burning of oil. Fuel savings and reduced maintenance costs usually more than repay the cost of continuous SR-155 treatment — and very little SR-155 is needed per 1,000 gallons of fuel oil! Details on Nalco SR-155 will be sent on request.

Write for Bulletin 46

NATIONAL ALUMINATE CORPORATION
6224 West 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco SYSTEM • Serving Industry through Practical Applied Science

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the cards on page 103, detach and mail

BOILERS, GENERATORS

101 Two-Drum Boilers — Photographs and detailed line diagrams describe two-drum, bent-tube boilers recently put into service. Boilers shown in this 14-pp bulletin are company's Class VF and VS. Principal data, including capacity, temperature and dimensions, are given. Henry Vogt Machine Co.

102 Oil or Gas Fired Automatic Boilers — Boiler, burner, controls and safety features of 10 to 500 hp oil or gas fired automatic boilers are described in this bulletin. Firing rates, dimensions and capacities are given for all models along with installation photos of some models. Boiler Engineering & Supply Co.

103 Steam Generator Design Data — Bulletin 2000, 28 pp, shows advance design features that distinguish this manufacturer's generator from other unit steam generators. Describes engineering differences of component features and includes numerous illustrations. Also shows how these components are constructed, assembled and tested. Another section gives comprehensive data and dimensions, and accessories for the units which range in size from 20 to 600 hp, for pressures to 250 psi. Preferred Utilities Mfg. Corp.

INSTRUMENTS AND CONTROLS

104 Wired Television — Bulletin 1025-A introduces company's new Utiliscope, which has same performance characteristics as previous model, but is improved in appearance and serviceability. Pictures monitor unit, camera and power unit utilized; explains how this equipment lets you "see where you can't look," and describes some advantages. Typical uses of the Utiliscope in centralized control applications of large power stations, remote observation of dangerous operations etc. are described briefly. Diamond Power Specialty Co.

105 Meters and Control Systems — Integrated control systems and individual meters for these systems are shown in 12-pp Bulletin 15-H. Boiler, combustion and feedwater controls are singled out for special attention, complete with photographs and schematics. Also included are measurement requirements for steam temperature, condensate, boiler feed pump control. Bailey Meter Co.

106 Boiler Water Controls — Illustrated Bulletin SC-2 is a 24-pp catalog designed primarily as a workbook to help in selection and application of company's safety devices for steam and hot water boilers and heaters. Book is organized to display products according to function: water feeders for steam and hot water boilers and for receiving tanks; low water fuel cut-offs for low and high pressure boilers, float operated switches, relief valves etc. Includes specialized variations, plus various components as utilized for liquid level control use. Capacity curves, dimensional drawings and engineering information. McDonnell & Miller, Inc.

107 Where Heat Can Damage — Eight-pp Form 4703 introduces the Alnor Pyrotac, a temperature control unit for automatically monitoring up to 20 temperature points a minute. Explains advantages, tells how unit works, discussing safety and protection features. Tells how manually operated pyrometer systems can be converted with motor driven switches. Illinois Testing Laboratories, Inc.

108 Automatic Controllers — Eight types of company's Model 40 controller, widely used in process applications, are described in 32-pp Bulletin 461. Shows how, with standard specifications, or available modifications, each type can be specifically engineered to its application, whether controlling temperature, pressure, flow, pH, conductivity or other variable. Each instrument is pictured with a typical process diagram. The Foxboro Co.

109 Electronic Combustion Control — Eight-pp Bulletin 22, covering company's Eyematic combustion control for oil-fired boilers, shows how, by means of an electric eye focused on a beam of light shining through the smokestack, this control regulates fuel-air ratio to provide constant boiler efficiency. Includes a schematic diagram of the control's operation. Brooke Engineering Co., Inc.

110 Indicating-Control Equipment — Bulletin PSC-1-452 describing specially engineered, custom-built switching, indicating and recording equipment for industrial, utility, municipal and other applications, shows some installations currently in operation. Information on its consulting-engineering services included. Wisconsin Electrical Mfg. Co.

111 Modern Scales — Condensed Scale Catalog 11, 28 pp, is a handy reference text on modern industrial scales, and covers some 1000 standard models weighing from 1/64th oz to 400 tons. A compact edition of company's big catalog, this new publication includes specifications, spot illustrations and essential information. It is indexed, arranged by types of weight indication. Features scales with beam indication, company's Tape-Drive dial, Weightograph projection and remote recorder. The Howe Scale Co.

MAINTENANCE

112 Electrical Maintenance Service — Booklet B-4766, 24 pp, on company's maintenance service for electrical apparatus presents a sound program based on the use of renewal parts, repair service plants and company's engineering and field service. Photos show special skill, testing devices and repair equipment available through strategically located repair plants. Improved design renewal parts are illustrated. Motor exchange service, periodic inspection and "on the spot" repairs described. Westinghouse Electric Corp.

113 Maintenance Problems of Power Industry — Now available to power engineers is this booklet containing 8 pp of information on heavy duty maintenance paints engineered to solve the special problems of power plants. Discusses 25 such products and explains importance of proper preparation and priming. A large selection chart lists alphabetically some 60 types of surfaces requiring protection — from boiler breeching to exterior walls — and tells products recommended for the job. Valdura Div., American Marietta Co.

114 Coatings for Condenser Protection — Highly informative, in view of the increased interest interest in sprayed-on synthetic rubber coatings for condenser maintenance, these two technical bulletins cover specific applications for company's coatings. Bulletin 6 discusses use in repair of water box castings, giving details on preparation, use of primer, cement, coverage, curing time and safety factors. Bulletin 3 gives similar information on use in condenser tube and sheet protection. Both available, state choice or both. Synco Corp.

115 Protecting Masonry Structures — This 20-pp booklet describes a heavy self-sealing protective coating, Dum-Dum Masonic, which can be applied many times thicker than paint and affords increased protection. Illustrations show restoration and protection of 19 types of masonry structures against wind, weather, fumes and heat. The Areo Co.

116 Protective Coatings — Subjects of special interest in this 4-pp condensed catalog include a list of chemical agents against which company's coatings have been found effective, five case history studies, and a three-point analysis of the advantages of maintenance painting by this method. Gives briefly the physical and protective qualities of all eight products. Prufcoat Laboratories, Inc.

117 Floor Care Manual — "Floors without Flaws" is a 12-pp practical guide for economical and efficient care of a wide range of floorings. Covers conditioning, repairing and maintenance methods for concrete, asphalt tile, cork, linoleum, magnesite, terrazo and wood. Twelve of company's floor maintenance products are discussed. A. C. Horn Co., Inc.

TWO POSTAGE-FREE CARDS are provided for you on page 103. List item numbers of all the bulletins you want

ELECTRICAL EQUIPMENT

118 Application of Large A-C Motors — Publication 1113, 18 pp, is an illustrated article discussing the characteristics of large a-c motors which fit them to industry requirements. Covers highlights of synchronous motors, induction motors and motor control and gives many hints on selection of motor types for specific applications. It is replete with charts, graphs and tables and photos showing construction of the various motor types. Electric Machinery Mfg. Co.

119 Squirrel-Cage Induction Motors — Construction features, ratings and dimensions of open drip-proof and splash-proof squirrel-cage induction motors in ratings of ½ to 100 hp are described in 6-pp Bulletin 51B6210D. Special modifications, such as totally-enclosed, vertical mounting, flange mounting and multi-speed construction, available for these motors explained. Allis-Chalmers Mfg. Co.

120 Motor Case Histories — Over 100 applications of this manufacturer's Life-Line motors are depicted in 35-pp Booklet B-4769. These case histories represent a wide range of industrial jobs and most of them are illustrated. Each tells the particular problems involved, the motor choice for the job, and the results. Westinghouse Electric Corp.

121 Four-Cycle Diesel — Bulletin 5202 gives design features, capacity tables and dimensions of manufacturer's Model 65 stationary diesel, an engine especially suited for utility plants, waterworks and sewage and general industrial plants. Describes different six- and eight-cylinder sizes available in capacities from 880 to 1500 hp, gives specifications of component parts and lists standard and extra equipment. The National Supply Co.

122 Electrical Connectors — Easy-to-read recommendation charts showing advantages of each connector type for specific applications in tapping and splicing aluminum conductor in overhead distribution are featured in Catalog AL 53, 36 pp. Contains illustrations, descriptions and listings of 18 types of connectors developed for such applications, and also details on installation tools and accessories. Includes tables of physical properties of aluminum cable and NEMA current ratings. A technical section outlines problems in connecting aluminum and presents solutions. Burndy Engineering Co., Inc.

123 Electrical Fittings — Brand new Catalog 52, 12 pp, describes a line of solderless wire connectors, cable and conduit fittings and wiring devices. Profusely illustrated, contains data on company's Pres-sure-connectors for wire splicing and terminating, insulated conduit bushings, box connectors for non-metallic sheathed cables, cable locknuts, knockout plugs. Includes specifications, dimensional data, application instructions. Buchanan Electrical Products Corp.

124 Circuit Breaker Study — Booklet B-5407, 35 pp, shows, by photos, the arc-quenching action of manufacturer's AB breakers. A "quick guide" to these circuit breakers gives their types, ratings, and standard and special features. For a better understanding of circuit breakers, a short history of their development is included and fundamental operating principles of modern units discussed. Engineering and application information is given for each of the eight types of the AB breakers. Method of calibration, operation of the De-ion quenchers and handle mechanisms, and modifications are covered. Westinghouse Electric Corp.

125 Watthour Meter Selection Tips — Here is a handy pocket-size guide, 52-pp worth, giving all necessary information needed to select and install any of the company's watthour meters. The bulletin, GET-2376, explains uses of the meters while pointing out basic considerations pertinent to selection. Illustrations and circuit diagrams included. In addition, instrument transformers and demand devices are discussed for energy and power measurement. General Electric Co.

126 Engineered Switchgear — Twelve-pp Catalog 521 illustrates range of manufacturer's switchgear, showing a wide variety of control equipment in low and medium voltage capacities. In addition, controls for special uses are shown. A discussion of company's engineering service tells of facilities for designing and manufacturing switchboards, control and distribution panels, and voltage regulators for industrial, pipeline and other control. Electric Service Engineering Co.

128 Solderless Power Terminals — A 16-pp catalog on heavy-duty power terminals and connectors for wire sizes 16 to 4/0, this book describes in detail company's many varieties of solderless types, together with tables to aid in terminal selection. Also shown and described are hydraulic and pneumatic precision hand tools. Aircraft-Marine Products, Inc.

MECHANICAL POWER TRANSMISSION

130 For Wide Ranges of Speed — Tachometers for speed measuring applications where a wide range of speed measurement is desired in a continuously indicating switchboard instrument are described in Technical Data Sheet 42P. Typical applications include acceleration test stands, turbine test, dynanometer test stands. Metron Instrument Co.

131 Hints on Babbitting Practice — In outlining basic steps for the prevention of common bearing failures, Bulletin 146, a little 16-pp booklet, covers everything from the choice of metal for a particular bearing application through the correct pouring practice to in-service maintenance. Proper lubrication, maintenance schedule, and operation at correct speed and load discussed. Federated Metals Div., American Smelting and Refining Co.

VALVES, TRAPS AND PIPING ACCESSORIES

132 Diaphragm Regulating Valves — Bulletin 513 describes construction and outstanding features of the company's new Class DV double-seated diaphragm regulating valve for use with control instruments. Chief feature of the valve, as reported, is the "flow-line contoured body" which provides high capacity at low pressure drop. Leslie Co.

SEE PAGE 103 for postage-free cards. List item numbers of bulletins wanted

133 Air Trap Selection — Convenient guide to selection and installation of air traps for automatic drainage of water from compressed air intercoolers, aftercoolers, receivers, separators and drip points, Bulletin 2021 includes physical data and list prices for both ball float and inverted bucket traps. Photos show typical installations. Armstrong Machine Works.

134 Dual Temperature Pipe Insulation — Data Sheet IN1.C3, 4 pp, describes pipe insulation designed to give maximum efficiency to pipe lines operating at low temperature or at alternate cycles of high and low temperatures, and to prevent condensation on pipes passing through warm, humid areas. Discusses thermal conductivity, vapor permeability, durability, other physical characteristics; explains application procedure. Includes selection table on recommended thicknesses. Owens-Corning Fiberglas Corp.

VENTILATING, DUST CONTROL

135 Ventilation-Air Conditioning Filters — Illustrated Bulletin 100, 8 pp, describes company's Staynew filters for ventilation and air conditioning applications. Contains specifications, engineering and performance data covering various types of filters recommended for removal of dust and other foreign materials by impingement method. Dollinger Corp.

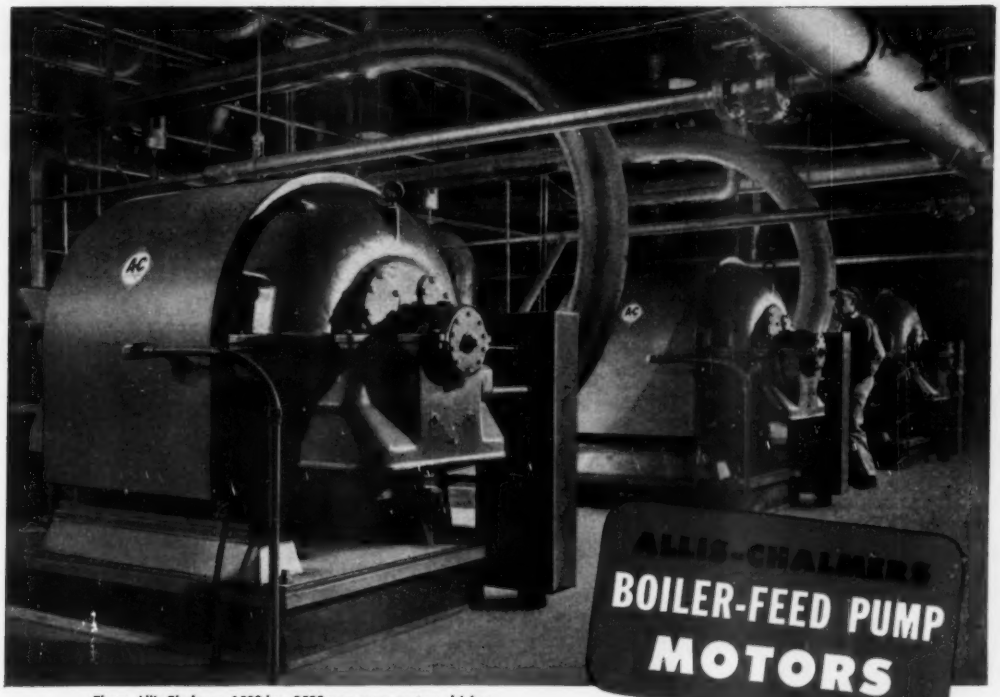
136 Industrial Dust Control — Bulletin 909A describes manufacturer's dust control equipment and its applications. Case histories are documented with photos and performance data indicating savings achieved. Featured in the 28-pp booklet is the CH system of control utilizing cloth type filters for the collection of finely divided dry dusts and affording high recovery at economical cost. Elements of the system are described and operation explained. Specifications given, also construction details. Application and engineering data tabulated. Pangborn Corp.

137 Manual of Exhaust Hood Design — Bulletin 270-E1, 24 pp, features engineering data on dust control systems for metal working industries. Illustrates and discusses the design of exhaust hoods for many operations in this field. Also, 61 photos of actual dust control installations show various methods of hooding dust sources. Includes tables of exhaust requirements, data on dust concentrations. American Air Filter Co., Inc.

MATERIALS HANDLING

138 Roller Gravity Conveyors — Form 642-OPC is a 28-pp booklet containing size and specification data on gravity conveyors along with detailed construction characteristics. Explains how to determine which roller is best suited to the application. Accessories are pictured and described so that a complete system can be planned, covering possible changes in direction, coordination of several lines and combination of gravity conveyors with live roll conveyors. Lamson Corp.

(Continued on page 117)



Three Allis-Chalmers 1500-hp, 3580-rpm cage motors driving pumps in Alabama Power Company's Gorgas Steam Plant.

Give Extra Protection TWO WAYS!

BECAUSE LOSS OF FEEDWATER can lead to extensive boiler damage, it is common practice to provide protection by means of a standby boiler-feed pump unit. It is equally good practice to insist on the additional protection of the operation-proved reliability of Allis-Chalmers motors.

YOU GET THESE FEATURES

As the result of a quarter century of development, A-C two-pole cage motors offer you these features:

- Ring-oiling adequate for prolonged emergency operation without forced-feed oiling.
- Equalizing air pressure chambers to positively keep oil out of motor windings.
- Air distribution arrangement that eliminates hot spots in both stator and rotor.
- Forged end rings, drilled for cage bars.
- *Dew-drop* bars that give better performance and stay tight in rotor core.
- Oxygen-free copper or deoxidized copper-base alloy bars and end rings to eliminate embrittlement from silver-brazing.
- Separate steel balancing rings for dynamic balancing without weakening end rings.

BULLETIN TELLS THE INSIDE STORY

For more details about these large two-pole cage motors, ask your nearby A-C representative for Bulletin 05B7550, or write to Allis-Chalmers, Milwaukee 1, Wisconsin.

A-3719

ALLIS-CHALMERS

Ready FOR ANY FUEL JOB

There's never any need for compromising on the fuel properties you require for your particular combustion job, when you use Beacon Coal. You'll find, in this comprehensive line, a fuel that's exactly suited to each application: domestic hand and stoker fired; commercial hand or stoker fired; general industrial; electric utilities; railroad; steamship bunker; coke and gas plants; and special uses. Mine locations and shipping facilities, as shown on the chart, permit the most advantageous distribution. And finally, the conveniently located sales offices bring the able services of Beacon representatives within easy reach.

NAME OF COAL	CHARACTER	MINE
Sonman	Central Pennsylvania Low Volatile	Sonman
Indian Creek	Central Pennsylvania Medium Volatile	Melcroft
Federal	Northern West Virginia	Federal #1
Bergoo		Bergoo #2
		Bergoo #4
		Bergoo #6
Bolair		Bolair
Eccles	Southern West Virginia Low Volatile	Eccles #5
Carswell		Eccles #6
		Helen #9
New River		Stotesbury #8
		Stotesbury #11
		Carswell
Pocahontas		Keystone
		Maitland
Eagle	Southern West Virginia and Eastern Kentucky High Volatile	Beards Fork
		Page
		Kopperston #1
Nora Gas		Kopperston #2
Powellton		Powellton #3
Wharton		Wharton #1
		Wharton #2
Weeksbury		Weeksbury

Want a copy of this chart for your fuel file?

If you'd like one of these ready-reference charts for file . . . just drop a line to the nearest office.

EASTERN GAS AND FUEL ASSOCIATES
BEACON COAL

EASTERN
PITTSBURGH • BOSTON

·This convenient Reference Chart shows why!

SEAM	COUNTY & STATE	RAILROAD	DIS-TRICT	SIZES MADE	DAILY PROD. TONS	NAME OF COAL
"E"	Cambria (Pa.)	Penna.	1	Lump; Slack; M/R; N&S; Stoker	2500	Sor[illegible]n
"B" or Miller	Fayette (Pa.)	B & O	1	M/R; N&S; Slack	1200	India[illegible]reek
Pittsburgh	Marion (W. Va.)	Monongahela; B&O	3	Stoker; Lump; Egg; Nut; N&S; Slack; M/R	10,000	Fed[illegible]l
Sewell	Webster (W. Va.)	Western Maryland	3	Lump; Egg; Jr. Egg; Nut; Stoker; Buckwheat; Slack; N&S	1500	Be[illegible]o
Sewell	Webster (W. Va.)	Western Maryland	3	Lump; Egg; Jr. Egg; N&S; M/R	1600	
Sewell	Webster (W. Va.)	B & O	3	Lump; Egg; Nut; Slack; M/R	1000	
Fire Creek	Webster (W. Va.)	B & O	3	Egg; Nut; N&S; M/R	2000	B[illegible]r
Beckley	Raleigh (W. Va.)	C&O; Virginian	7	Egg; Stove; Nut; N&S; Slack	2000	Be[illegible]y
Sewell	Raleigh (W. Va.)	C&O; Virginian	7	M/R; N&S; Slack	1000	Se[illegible]ll
Pocahontas #3	Raleigh (W. Va.)	C&O; Virginian	7	Stove; Nut; N&S; Slack	2500	
Pocahontas #4	Raleigh (W. Va.)	C&O; Virginian	7	Stoker; M/R; Slack	2000	New[illegible]ver
Pocahontas #4	Raleigh (W. Va.)	Virginian	7	M/R; Slack	1800	
Pocahontas #3	McDowell (W. Va.)	N & W	7	Stoker; Egg; Stove; Nut; N&S; Slack; M/R	2500	
Pocahontas #3	McDowell (W. Va.)	N & W	7	Stoker; Egg; Stove; Nut; N&S; Slack; M/R	5000	Poca[illegible]ntas
Pocahontas #4	McDowell (W. Va.)	N & W	7	Stoker; M/R; Slack	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R	1500	
Eagle	Fayette (W. Va.)	Virginian	7	M/R; N&S	1000	E[illegible]e
Eagle	Wyoming (W. Va.)	Virginian	8	Slack; N&S; M/R	3000	
Campbells Creek	Wyoming (W. Va.)	Virginian	8	Slack; N&S; M/R	3500	No. [illegible]Gas
Powellton & Eagle	Fayette (W. Va.)	C & O	8	N&S; M/R	2000	Po[illegible]ton
Hernshaw	Boone (W. Va.)	C & O	8	Lump; Egg; N&S; M/R	3500	Wh[illegible]on
Hernshaw	Boone (W. Va.)	C & O	8	M/R; N&S	2500	
Elkhorn #3	Floyd (Ky.)	C & O	8	Block; Egg; Slack; M/R; N&S	1000	We[illegible]bury

GAS AND FUEL ASSOCIATES

CHICAGO • CLEVELAND • DETROIT • NEW YORK • NORFOLK • PHILADELPHIA • SYRACUSE

For New England: New England Coal & Coke Company For Export: Curtiss, Gurnee & Boffin, Inc.

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-paid cards on pages 103–104 for your request. Just list the numbers of the items you'd like to know more about

1—FAULT LOCATOR

For use on power lines, is radar-type electronic instrument

The Metrofault uses the radar or pulse reflection technique for locating faults on open wire lines in ranges of 10, 30, 100 and 300 miles, or 12 miles in cables. A unique feature announced is the ability to locate "opens" as well as "shorts" and "grounds."

A transmitter generates an intermittent short duration d-c pulse, which is applied to the line under test, and travels along the line at about the speed of light. When a change in line impedance is encountered, a portion of the pulse is reflected — and reflected pulses or echoes return to the Metrofault terminals at the same speed as the outgoing pulse.

Transmitted pulse and returning echoes are shown on a linear time base or "sweep" of a cathode ray tube, appearing as deflections from the horizontal sweep line. As different echoes arrive back at various time intervals — depending on the distance out on the line where the impedance occurs — so will an echo appear at corresponding distances along the sweep, which is calibrated directly proportional to the line. Distances are measured by a controlled deflection in the sweep, called a step. A brochure on the Metrofault is offered by manufacturer. Metrotype Corp.

2—CINDER CRUSHER

For power plants, reduces cinders to marketable small size

This three-roll crusher gets cinders to a size suitable for use in cinder concrete block plants, producing 15 tons of minus $\frac{3}{8}$ in. and up to 50 tons of minus $\frac{3}{4}$ in. per hour. Size of gears with which unit is equipped provide a coarser or finer range of crushed cinders. It can be permanently mounted above bin for loading

cinders into trucks, or portable units are also available.

The crusher handles up to 6 in. size feed. A large hopper and enclosed rolls are incorporated to prevent spillage and direct cinders to crushing rolls. One crusher roll handles preliminary reduction and directs the partially crushed material into the other two rolls. All rolls are made of Ni-Hard and are of the spring release type. Eagle Iron Works.

3—SILICONE LUBRICANT

Is stable at extreme temperatures and resistant to oxygen

Valve Seal A is described as a nonmelting lubricant with properties especially useful in pressure lubricated plug valves, automatic control valves, flow meter bearings and pump packings. Manufacturer says it has three outstanding properties as an industrial lubricant: It is stable over a wide temperature span, retaining a grease-like consistency from −40 to 500 F. It has excellent resistance to oxygen and good resistance to a wide variety of chemicals and gases. It is immiscible in water and not completely soluble in any solvent, although it can be dispersed by some. Bulletin VSA 1 gives data on properties, applications and service recommendations. Dow Corning Corp.

4—ION EXCHANGE RESIN

With high regeneration efficiency, low leakage characteristics

Now available for general use is Amberlite IR-112, a low-cost medium capacity cation exchange resin said to possess all desirable physical and chemical properties of the polystyrene nuclear sulfonic acid class of exchangers. It is described as resistant to oxidizing and reducing media, as well as solvents, as stable up to 250 F and over the entire pH range, and as the most porous cation exchanger developed for commercial use.

Operation with Amberlite IR-112 is expected to be economical because its cost per unit volume is low and extensive regeneration techniques are not generally required. This advantage, and its efficient exchange characteristics in both hydrogen and sodium cycle operation suggest such applications as split stream dealkalization for boiler feed, and processing applications requiring soft, dealkalized water. Operating economy is also anticipated for industrial and municipal water softening units where water of low or medium hardness must be conditioned. Technical data sheets on this resin available. Rohm & Haas Co.

5—NEW TYPE BEARINGS

Are designed with rollers aligned at the pitch line

Not needle bearings, not journal bearings and not cylindrical roller bearings, the new Pitchlign Bearings are said to combine the best features of all three. According to their manufacturer, these bearings have the same dimensional advantages as needle bearings, offer roller alignment characteristic of cylindrical roller bearings, and have the ruggedness, mounting flexibility and easy maintenance of journal roller bearings.

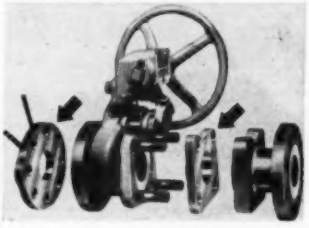
The rollers can't cock or skew, it is said, because they're kept in alignment by cage contact at their pitch line — and overall efficiency of the cage is not affected by accumulated tolerance and wear of load-carrying surfaces because it is supported by the two integral flanges of the heavy outer race. Pitchlign Bearings can be mounted horizontally or vertically and are said to be especially adapted for use on high speed shafts. Tests indicate good service life. Roller Bearing Co. of America.

6—HEATED VALVES

With electric heating elements, are offered for low temperature use

Announced as the first commercially successful electrically heated valves, these are designed to keep valve mechanisms clear of frost and ice in liquid carbon dioxide lines at temperatures as low as −110 F. Other applications being developed include both hot, cold and viscous liquid and gas lines, as well as uses where heated valves have formerly been economically impractical.

The single-disc type valves require the



heating element shown at right. Double-disc valves can be equipped with both elements illustrated. Heat from the elements is transmitted directly to the valve seats, and thus heat the entire flow opening through the valve, as well as the operating mechanism.

Heated valve sizes from 2 to 6 in. are available, with pneumatic, hydraulic, solenoid or manual control. Heating elements can be provided for 110- or 220-v operation. Further details and prices are available. Okadee Co.

7—RUBBER HEATING MAT

For under-foot comfort, has built-in radiant heating unit

For use in refrigerated areas of plant, or wherever cold working conditions are encountered, this heater looks like a high grade rubber floor mat. Its center, however, contains a layer of electrically conductive rubber which constitutes the heating element. It operates on 110-v current which can be supplied from baseboard outlet or lamp socket. Normal operating temperature for the heater is about 35 deg above surrounding temperature — warm enough for comfort but not hot enough to feel. Mechanical Goods Div., U. S. Rubber Co.

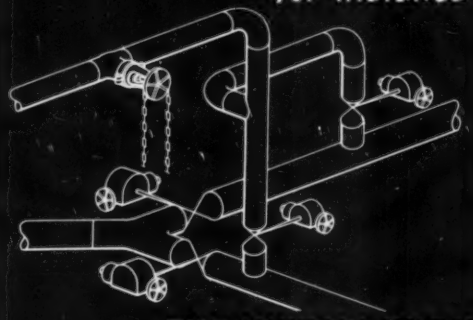
8—FORTIFIED LUBE OIL

Is developed to extend diesel and gasoline engine service life

Rimula Oil is said to feature a combination of additives never before attained on a commercial basis, and is designed to lengthen the serviceable life of automotive type diesel engines as well as certain gasoline engines operating in indus-

Can You Rate Your Valves This Well?...

on Main Steam Service for instance



THE INSTALLATION

VALVE SERVICE RATINGS

MAINTENANCE COST:	None to date
FEATURES:	Highly practical Pressure-Seal design
SUITABILITY:	Eliminates bonnet joint leakage
SERVICE LIFE:	Now more than 4 yrs.
PRICE:	In line for this modern design
AVAILABILITY:	Regular item in Crane line

Crane Pressure-Seal Gate Valve on 8-inch main steam lead to house turbine. Steam conditions: 850 psi at 900 Deg. F. Southwark Station, Philadelphia Electric Co.

THE HISTORY

This valve was installed on a trial basis in the station's last extension program. In service now more than 4 years, this 900-Pound Crane Pressure-Seal Bonnet Gate Valve has completely eliminated any need of bonnet joint maintenance. Under constant high pressure/high temperature conditions, it remains perfectly tight at bonnet and stem; needs no costly attention.

Never, says the customer, does this Crane valve stick at the disc, even though operated infrequently. Its operation is as smooth and positive today as when first installed. As a result of this performance, the customer is continuing to specify Pressure-Seal type valves.

THE VALVE

Universally recognized for simplified development of the modern pressure-seal bonnet principle, Crane Pressure-Seal Gate Valves combine many added refinements. For example, their highly compact, weight-saving design reduces erection costs; streamline body contouring saves insulating labor and material. See your Crane Catalog or Crane Representative for complete details on these valves—in gate, globe, angle, and stop-check patterns; in 600, 900, and 1500-Pound pressure classes.

The Complete Crane Line Meets All Valve Needs. That's Why

More Crane Valves Are Used Than Any Other Make!

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

trial stop-and-go, low temperature service. According to company, this highly fortified oil cuts down engine wear from corrosion and fouling, with consequent reduction in oil consumption and frequency of overhauls.

Rimula Oil was developed to solve certain problems caused by operating conditions aggravated by low loads, high sulfur and low temperature operations. Company says the higher first cost is offset by extended engine life by elimination of ring sticking and piston lacquer. Shell Oil Co.

9—HEAVY OIL BURNERS

In 25 and 40 gph capacities, offer simple installation, operation

These two new burners are the AM5-H and the AM6-H. The former has a 25 gph capacity and an overall width of 20 in. (11 in. less than the model it replaces), permitting more practical side-by-side installations. And the height of the center of the combustion cone to the floor is only 8½ in., making it unnecessary to pit in front of the boiler on many jobs. It is also lighter than former model and includes switch panel box, in which relay and motor starter are mounted.

The AM6-H, shown at high fire stage, has a maximum capacity of 40 gph. It uses virtually the same casting as the AM5-H, but has a 3 hp instead of a 2 hp motor, a larger oil pump dry oven and air diffuser. Cleaver-Brooks Co.

10—LOAD-BREAK DEVICE

Is lever attached to fuseholder, for open-dropout cutouts

This new device is intended to offer more safety to linemen while opening circuits under load, and to enable them to sectionalize and isolate lines and switch capacitor banks and other equipment. Company says it permits mechanical tension and resulting mechanical breakage at fusible element of fuse link.

Manual operation with a switchstick is by pulling down the switchstick inserted in the eye of the load break lever. Load current interruption occurs within the fuseholder in a manner similar to cutout operation under low-fault current conditions.

The load-break device is available on 100 amp, 7.8-kv and 15-kv open-dropout cutouts. Cutouts now in service can be changed to load-break operation by replacing an old fuseholder with one having the load-break device. Distribution Transformer Dept., General Electric Co.

11—STEAM SEPARATOR

Cuts costs by putting reflash steam to work at other jobs in plant

Recovering excess heat from reflash steam for use in low-pressure heating or process lines can mean real savings in plants having large amounts of high-pressure condensate or continuous blowdown. In this reflash steam separator the discharge line from high-pressure steam traps is run into the separator which is vented (connected) into the low-pressure heating or process steam line. Water remaining after reflash steam is removed may be returned to boiler for re-use, put through an exchanger, or exhausted. Strong, Carlise & Hammond Co.

12—SMALL PUMPS

Single-stage, double suction, for general hydraulic service

New design improvements in this company's Class DMV-DHV Pumps include the use of double mechanical shaft seals with sealed, pre-lubricated ball bearings, to provide a compact, totally enclosed pumping unit that requires minimum attention and maintenance and takes less floor space. Built in 3, 4, 5 and 6 in. sizes, the DMV (for medium heads) and the DHV (for high heads) the pumps are intended for use at temperatures to 200 F, capacities to 2100 gpm and pressures to 150 psi.

According to manufacturer, the double shaft seal affords more efficient sealing and prevents air leakage into pump when it is operating under suction lift; also it has a longer service life under conditions in which pump is handling gritty and abrasive liquids. Through standardization possible with this design, three spare parts kits serve all eight pumps in the line. Ingersoll-Rand Co.

13—REGULATING VALVE

Double-seated diaphragm type, for use with control instruments

The Class DV Valve is offered to meet requirements of the various process industries, and is said to provide, as standard equipment, features usually found only in specially designed valves.

Chief among its features is a flow-line contoured body designed to provide ISA standard face-to-face dimensions with highest capacity, lowest turbulence and body pressure drop. Renewable interchangeable seat rings are incorporated to simplify maintenance. Self-aligning top and bottom guides are another advantage where maintenance may be performed by inexperienced persons. The valve is available in sizes from 1½ to 10 in. for pressures to 600 psi, with screwed and flanged ends. Leslie Co.

14—AUTOMATIC SPRINKLER

Is developed to "fight fire at the molecular level"

By diluting the active ingredients of flame, the new automatic ProtectoSpray puts out fires faster, company explains, and when used for special protection, such as high piled tire storage, it reduces

ceiling scorching and checks the spread of the fire with less water.

According to company, the heat from a fire normally raises the temperature of nearby flammable material to its distillation and ignition temperatures. The automatic ProtectoSpray diverts this heat to vaporize water droplets. This removal of heat checks the spread of fire and the resultant water vapor dilutes the flame gases so they cannot burn. Complete details on sprinkler may be had on request. Grinnell Co., Inc.

Want more details on these new products? Use the post cards provided on page 103

15—TRANSFORMER BUSHING

With simplified construction to minimize porcelain breakage

Pressure clamping—replacing cemented-on clamping rings—is credited with lessening the possibility of porcelain breakage in this high voltage transformer bushing, the Type LC. Smaller and lighter, the new type will decrease the height of power transformers from 1 to 5 in. It is liquid-filled and completely sealed to prevent internal corona discharges under high stress.

Company engineers say that even improper tightening of the bushing's support flange won't cause porcelain breakage because the porcelain is held under compression between this flange and a heavy spring washer, and compression is the force porcelain is best able to resist.

The Type LC is for large power transformers in 15 and 25 kv class, power and distribution transformers in 34.5, 46 and 69 kv classes, and oil circuit breakers in the 25 and 46 kv classes. Power Transformer Dept., General Electric Co.

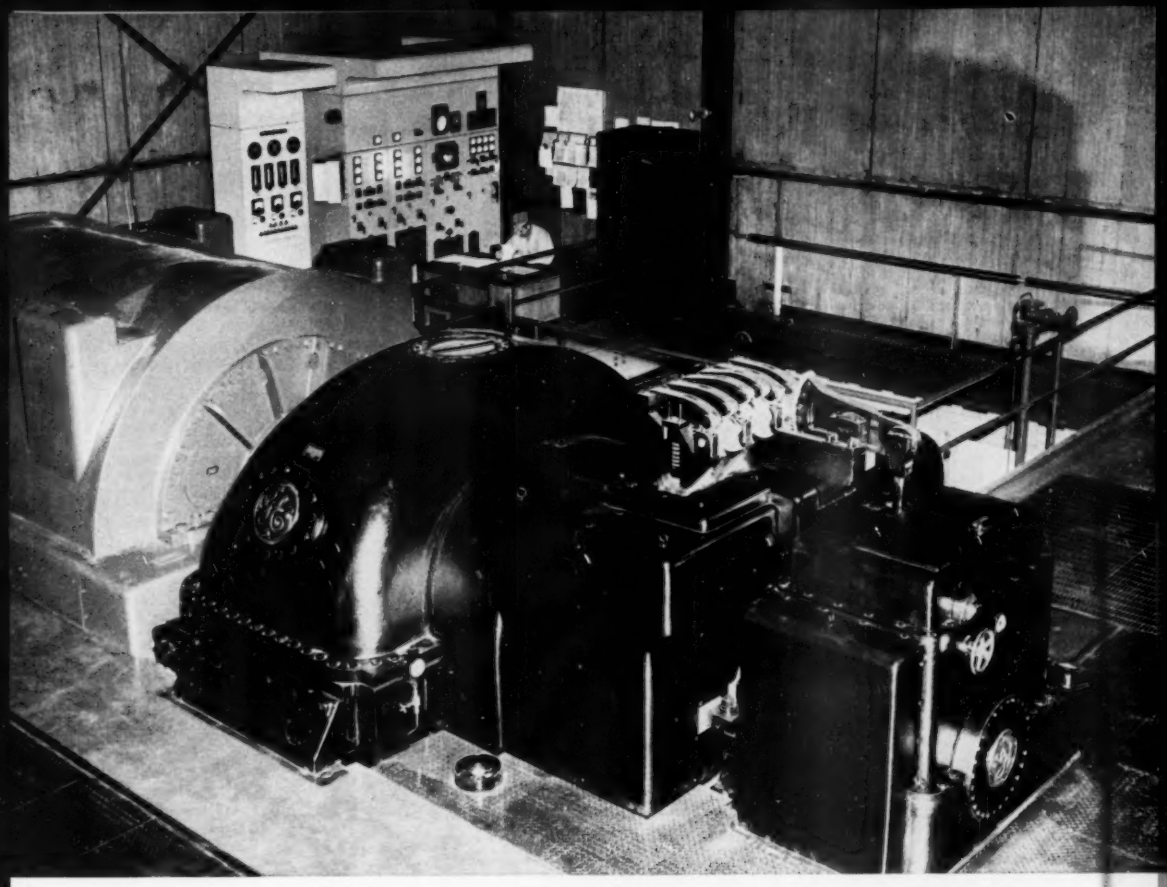
16—VACUUM DEAERATOR

Removes oxygen and free CO_2 to protect against corrosion

A common method of deaeration for steam boilers is to raise the temperature of the water to the boiling point to make all gases insoluble and to scrub the boiling water with fresh steam. However, if the water is to be used cold, it may be more practical to lower the boiling point by carrying out the process under vacuum, says manufacturer of this vacuum deaerator.

In operation, water is sprayed into the deaerator shell maintained under a vacuum or at an absolute pressure approximating the boiling point. Pressure in the unit is held at a vacuum of 29.75 in. with respect to a 30 in. barometer when deaerating water at 40 or 50 F. Entering water is distributed over the top surface of a stack of trays. This packing subdivides water particles repeatedly to expose new water surfaces to the gaseous phase. Non-condensable gases and water vapor are drawn up through the packing and removed by vacuum pumps or steam ejectors.

These deaerators are also suggested for the removal of oxygen and CO_2 from surface water supplies which may be pumped great distances to point of use; for removal of oxygen from waters used for unit coolers or condensing units for air conditioning and cooling systems;



Assures trouble-free lubrication for life of new turbine

There is good reason to believe that this new 15,000-KW turbine at Ottertail Power Company's Ortonville, Minnesota, plant will never have to be shut down for oil replacement, oil system cleaning, or because of oil acidity troubles. The basis for this conviction can be found in the company's own experience with NONPAREIL Turbine Oil, lubricant for the new unit.

Since 1931, the Ottertail Power Company has put NONPAREIL into several turbines. In one of those first units, NONPAREIL has now served for 21 years, and the original fill of oil has never needed to be replaced. Although the lubricant has not been removed for treating, it has maintained a neutralization number below 0.09 mg. KOH/gm. The oil system has not required cleaning.

With this evidence of long life is the written guarantee given with each fill of oil that NONPAREIL will last as long as the turbine and will maintain a neutralization number below 0.15 mg. KOH/gm.

You can assure trouble-free lubrication for the life of your turbines by using NONPAREIL Turbine Oil. Phone your Standard Oil Company (Indiana) office for the services of a Standard lubrication specialist. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

NONPAREIL
TRADE MARK
Turbine Oil

STANDARD OIL COMPANY

STANDARD

SO

(Indiana)

and removing oxygen or CO_2 from demineralized or chemically treated water to prevent corrosion of steel piping. The Permutit Co.

17—SEALED BALL BEARINGS

Are designed to keep the dirt out and hold the lubricant in

Red Seal Bearings feature a seal made of duPont Fairprene which, company points out, is not affected by petroleum-base lubricants, normal operating temperatures or aging. An effective sealing design, providing sealing with very light contact and low friction, extends the seal below the steel retaining ring to form a flexible lip which lightly touches a smooth, uniform chamfer of the inner ring. Retaining rings have circular-formed ribs for rigidity, and are staked during manufacture. These bearings are shipped factory lubricated and are interchangeable with non-sealed bearings. SKF Industries, Inc.

New Hand Tools with Talent

18—CABLE CUTTER

Is designed to cut clean and smooth, prevent ridges

Distinctive feature of this new cutter is the heart-shaped design of the opening between the jaws. Company says this results in cuts free of jagged ridges across the

center of the cable and no deformation of cable, even in extra flexible constructions, and individual strands are free from burrs.

The cutter, designated Catalog 365, is said to be equally well adapted to bare or insulated copper or aluminum cables up to 500,000 cm, accommodating outside diameters to 1¼ in. It is described as fast and easy to use, and especially suitable for preparing cable ends for insertion in precision type fittings because cut end is compact, almost round. The Thomas & Betts Co., Inc.

19—ONE-HAND WRENCH

Self adjusting; with teeth for pipes, hexagon for nuts

Announced as decidedly handy for hard-to-get-at places, this wrench is available with either plain hexagon jaw, shown, or with teeth. Its

only moving part is one side of the jaw, actuated by a spring. The wrench is made in Germany, may be had in forged steel or chrome vanadium. An illustrated bulletin gives the full range of sizes and prices. Tec Imports.

20—A-C VOLT-AMMETER

Is clamp-type, hand size, instant measuring instrument

The Type AC-1 Volt-Ammeter supplements this manufacturer's line of Tong Test Ammeters. With the new instrument readings are made without breaking circuit or insulation. To read amperes the trigger is pressed to open the insulated jaws so they can be encircled around power cable or bus bar. The jaws accommodate cables to 1½ in. dia, bars up to 2 by ½ in. Four amperage ranges are available from 0–12 to 0–600 a-c amp. Voltage leads may be quickly plugged into the handle. Two voltage ranges are available: 0–150 and 0–600 a-c volts.

The Type AC-1 weighs less than 2 lb and its over-all dimensions are 11 by 3½ by 1⅞ in. Trigger and housing are durable molded phenolic material. Columbia Electric Mfg. Co.

21—HIGH SPEED DIESEL

Is 1000-hp engine featuring compact size and reduced weight

The Viking is said to be little more than half the size and weight of similar engines and is designed for simple maintenance. Tests are reported to show that the small size of the parts and their low cost keep maintenance costs comparable with those of low speed engines. Now in production, the Viking is made in six- and eight-cylinder units both with 8-in. bore and 9-in. stroke. According to company, the supercharged Viking Model VDS-8-S has been tested for intermittent service at a maximum of 1500 hp at 1500 rpm. The engine's over-all length is 134⅝ in., height 64 in. and width 37 in. Sterling Engine Co.

22—MASONRY BLADES

For difficult edge cuts, grooving cuts, grinding type cuts

Reinforced internally with layers of strong fabric, and further protected by a "safety web" molded into the blade surface, the Tuffie Blade is claimed to be virtually indestructible. Because of its ability to withstand twisting strains and binds, it is particularly suggested for any make of hand power saw.

Manufacturer says the Tuffie is suited to cutting concrete block, cinder block, most common brick and softer ranges of stone. Because of its extreme toughness the Tuffie is not recommended for cutting very hard vitreous material, such as glazed tile, acid proof brick and terra cotta. Blade sizes range from 12 to 18 in. dia for masonry saws and 6 to 9 in. dia for hand power saws. Illustrated literature, prices and specific recommendations available. Eveready Briksaw Co.

23—TESTING INSTRUMENTS

Compact, lightweight circuit tester, power circuit analyzer

The Model 102 Circuit Tester and Model 247 Power Circuit Analyzer are announced as having many practical maintenance applications. The circuit tester (d-c ranges of 1–5–25–125–250–500 v, 1–10–50 mil, and a-c ranges of 5–25–125–250–500 v, 0.25–1–5–25 amp, 0–1000 ohm, 0–1 megohm) is suggested for testing signal and alarm circuits, servicing industrial electronic and communication systems, testing motors and lighting loads and maintenance of power systems.

The power circuit analyzer, with ranges of 150–300–600 v, 5–25–125 amp, and 0.6 to 60 kw, is for locating unbalanced loads; overloaded, underloaded or defective motors; low power factor, and excessive circuit voltage drop. It may be used on single phase, 2- and 3-wire, three phase 3 and 4-wire networks or two phase systems. Both instruments have shielded meters, come in oak carrying cases. Instrument Laboratories.

24—PUMP PACKING

Available in spiral or ring form; resists many solvents

Results of extensive tests are reported to show that Sav-On Pump Packing offers good resistance to disintegrating effects of aliphatic and aromatic hydrocarbons, such as pteroleum ether, solvent naphtha, gasoline, benzine and toluol. Manufacturer of the new packing (No. 701 in spiral form and No. 705 in ring shape) says it won't swell, soften or disintegrate. Its composition, in addition to a special binder to resist solvents, includes shredded metal, asbestos and lubricating graphite in woven cotton casing.

Operating characteristics suggest application on all types of centrifugal, rotary and reciprocal pumps operating at temperatures to 550 F, pressures to 1000 psi. Engineering data is available. Sea-Ro Packing Co., Inc.

25—ANNUNCIATORS

Plug-in automatic alarm type, in hermetically sealed units

Tel-Alarm is a new type of alarm unit for remote signalling of failure or other-than-normal operation of valves, pumps, heaters. These alarms are of "unitized" construction permitting a variety of circuit arrangements from one basic alarm unit. This is made possible by a switchboard circuit header wired into the basic relay in different ways — depending on the circuit desired. Company says this feature makes manufacturing easier and results in a low cost, standardized unit. Bulletin 440 describes Tel-Alarm in detail. Tigerman-Anderson Co.

Use post cards on page 103 to ask for more information on any of these products

26—CUP EXPANDER

To increase efficiency of hydraulic, pneumatic cylinder packings

ES-11 Cup Expanders have been developed to eliminate leakage in hydraulic and pneumatic cylinders. They are designed to insure positive sealing action of cup packings at all times by exerting controlled pressure on the packing lip so it maintains constant contact with the cylinder wall. These expanders are recommended for use on pumps, compressors, feed mechanisms, lubricators and similar applications, and are available in sizes for use with packing diameters from 1¼ to 2¾ in. They are made from 0.01 in. thick rolled strip brass and they are reported to be impervious to the effects of brine, gasoline and alcohol. HPL Mfg. Co.

3 reasons why every power engineer should know about Dearborn Formula 702

2. FORMULA 702 IMPROVES HEAT TRANSFER, REDUCES STEAM PRODUCTION COSTS
The wax-like microscopic film causes water to condense in drops rather than as an insulating blanket of water. Thus heat transfer areas are increased, thereby reducing the cost of steam production.
1. FORMULA 702 PREVENTS RETURN LINE CORROSION
Formula 702, a filming-type amine treatment, forms a continuous, microscopic film on the surfaces of return lines to protect them against both oxygen and carbon dioxide corrosion.
VAPOR PHASE (steam)
3. FORMULA 702 REPAIRS EXPOSED AREAS
The amine film forms right over rust scale, too. And, should the scale fall off, the exposed surface is immediately and automatically protected by the formation of new film. Once film is formed, it is maintained by reduced dosages.
DISPERSED PHASE (water)

BASIC PATENTS
Dearborn holds the basic patents (U.S. Pat. 2400543) for the use of filming amines for treating water.

This cross-section of a return line, showing how *Dearborn Formula 702*, which is fed directly into the boiler, works to eliminate costly corrosion, reduce maintenance, avoid shutdowns and protect valuable equipment. If the pH value of your steam condensate is excessively low, it will pay you to discuss Formula 702 with your Dearborn Engineer.

DEARBORN CHEMICAL COMPANY • Merchandise Mart Plaza • Chicago 54, Illinois

You'll Want a Copy of This Bulletin

Bulletin 5013, which outlines the causes of return line corrosion and the method of cure with Formula 702, will be sent on request.

Dearborn Chemical Company
Merchandise Mart Plaza, Dept. PG
Chicago 54, Ill.

( ) Send a copy of Bulletin 5013
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Name.....
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Dearborn
TRADE MARK REGISTERED
THE LEADER IN WATER TREATMENT AND RUST PREVENTIVES

POWER PLANT *Construction News*

Jones Mill, Ark. — General Motors Corp., Fabricast Division, General Motors Bldg., Detroit, Mich., plans power house at proposed new plant on 40-acre tract of land at Jones Mill, for production of aluminum castings. Main structure will approximate 105,000 sq ft floor space. Entire project reported to cost about $3,000,000.

El Centro, Calif. — Imperial Irrigation District, El Centro, will begin work for new hydroelectric power plant on All American Canal, El Centro, to be known as Drop No. 2 Hydro Plant. Installation will include two outdoor type hydraulic turbines and generators, with penstocks, draft tube outlet, and other auxiliary structures. No official estimate of cost announced.

San Francisco, Calif. — Pacific Gas & Electric Co., 245 Market St., is arranging for additional stock issue to total about $75,000,000, proceeds to be used for expansion and improvements in power plants, power substations and transmission lines, including certain hydroelectric power developments now in progress. Complete construction program during 1952 will represent an investment of $162,000,000.

Ventura, Calif. — Shell Oil Co., 100 Bush St., San Francisco, Calif., plans power house at new plant for production of ammonia at Ventura, where large tract of land has been acquired. It will comprise a number of units, and is reported to cost in excess of $5,000,000. Natural gas will be used as fuel.

Bloomfield, Conn. — Kaman Aircraft Corp., Bradley Field, Windsor Locks, Conn., has plans for new boiler plant at branch airplane plant at Bloomfield. No estimate of cost announced. Proposed to begin work soon. Thompson & Barnum, 250 Park Ave., New York, N. Y., are engineers.

Middletown, Conn. — Hartford Electric Light Co., 266 Pearl St., Hartford, Conn., will soon begin superstructure for new steam-electric generating plant at Middletown, reported to cost about $14,000,000, with turbine-generators, high-pressure boilers and auxiliary equipment, including extensions in transmission lines. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer.

Jacksonville, Fla. — Jacksonville Electric Dept., foot of Laura St., is carrying out expansion in municipal electric-generating plant at Talleyrand Ave. and 30th St., work to include installation of new 40,000-kw. turbine-generator unit and auxiliary equipment.

East Dunkirk, Ind. — Indiana & Michigan Electric Co., South Bend, Ind., has approved plans for new steam-electric generating station at East Dunkirk. Turbine-generators, high-pressure boilers and auxiliary equipment will be installed for large capacity. Entire project is reported to cost about $41,800,000, with power substations, transmission lines and other operating facilities. Project has been approved by Defense Production Administration.

Des Moines, Iowa — Iowa Power & Light Co., is arranging financing through sale of additional stock, approximating close to $5,000,000, proceeds to be used in connection with 1952 expansion and improvement program in power plants, power substations, transmission lines and other facilities. As reported in these columns recently, additions will be made at steam-electric generating plant at Boone, Iowa.

Madisonville, Ky. — Municipal Light & Water Dept., plans new municipal electric-generating plant, to cost about $850,000. Details will be determined at early date, when engineer is selected to prepare plans.

Jefferson Parish, La. — American Cyanamid Co., 30 Rockefeller Plaza, New York, N. Y., plans steam-generating plant at proposed new factory in Jefferson Parish, where site has been acquired, for production of a number of chemical specialties. Work will consist of several large buildings, with entire project reported to cost approximately $45,000,000. Electric power service will be furnished by Louisiana Power & Light Co., New Orleans, La., with power substation to be erected on plant site.

Wiscasset, Me. — Central Maine Power Co., Augusta, Me., plans expansion in Mason steam-electric generating plant at Wiscasset, with installation of additional generating facilities, high-pressure steam-generating equipment and other facilities for increased capacity. Entire project is reported to cost about $8,700,000, including power substations and transmission lines. Project has been approved by Defense Production Administration and work will begin at early date.

Luke, Md. — West Virginia Pulp & Paper Co., 230 Park Ave., New York, N. Y., plans expansion in power plant at pulp and paper mill at Luke, with installation of additional equipment. Cost reported about $375,000. Project will be carried out in connection with extensions in main mill units, entire program to represent a total reported investment in excess of $7,000,000. Approval has been granted by National Production Authority.

Boston, Mass. — New England Power Co., 441 Stuart St., has disposed of a bond issue of $5,000,000, proceeds to be used for expansion in power plants and system, including increased generating capacity, power substations and other operating facilities.

Worcester, Mass. — Worcester County Electric Co., 11 Foster St., has disposed of a bond issue of about $4,000,000, proceeds to be used for expansion in power plants, power substations and transmission system.

Bay City, Mich. — Municipal Light Dept., City Hall, plans expansion and improvements in municipal steam-electric power plant, reported to cost about $500,000, including installation of additional equipment.

Bessemer, Mich. — Puritan Mining Co., care of Pickands, Mather & Co., Sellwood Bldg., Duluth, Minn., plans new boiler plant, about 55 x 68 ft, at iron ore mining properties at Bessemer. Work will be carried out in connection with a general expansion program, reported to cost in excess of $500,000. Harold S. Starin, first noted address, is architect.

Minneapolis, Minn. — Northern States Power Co., 15 South 5th St., will expend about $35,000,000 during 1952 on expansion in generating facilities, power substations and transmission lines. Work is in progress on new steam-electric generating plant at Black Dog Lake, near Minneapolis, with ultimating rating of 300,000-kw., comprising five 60,000-kw. units, the first of which is scheduled to be ready for service in fall.

Brookhaven, Miss. — Johnston Lawnmower Corp., Ottumwa, Iowa, power and other lawnmowers, and equipment, plans boiler house at new branch plant at Brookhaven. Factory will be constructed by municipal officials and occupied by company under long-term lease. Cost reported approximately $600,000. Work scheduled to begin at early date. John Turner, 221 North President St., Jackson, Miss., is architect.

Grandview, Mo. — Paper Container Mfg. Co., 28 East Jackson Blvd., Chicago, Ill., paper cups, plates, etc., plans boiler house at proposed new converting plant at Grandview, where site has been selected. Entire project is reported to cost over $400,000. Proposed to begin work during summer.

La Platte, Neb. — Allied Chemical & Dye Corp., 61 Broadway, New York, N. Y., plans power house at proposed new plant for production of nitrogen fertilizer materials, near La Platte, vicinity of Omaha, where tract of land is being selected. Natural gas will be used as fuel, as well as for processing operations. Entire program is reported to cost about $25,000,000. Application for permission has been made to National Production Authority, Washington, D. C.

Gibbstown, N. J. — Hercules Powder Co., Chemical Dept., Delaware Trust Bldg., Wilmington, Del., plans power house at proposed new plant on Delaware River, near Gibbstown, where tract of about 275 acres of land has been secured. It will comprise several large production units for manufacture of hydrocarbon chemicals, including phenol, acetone, etc. Entire development reported to cost about $8,000,000. Work will begin at early date.

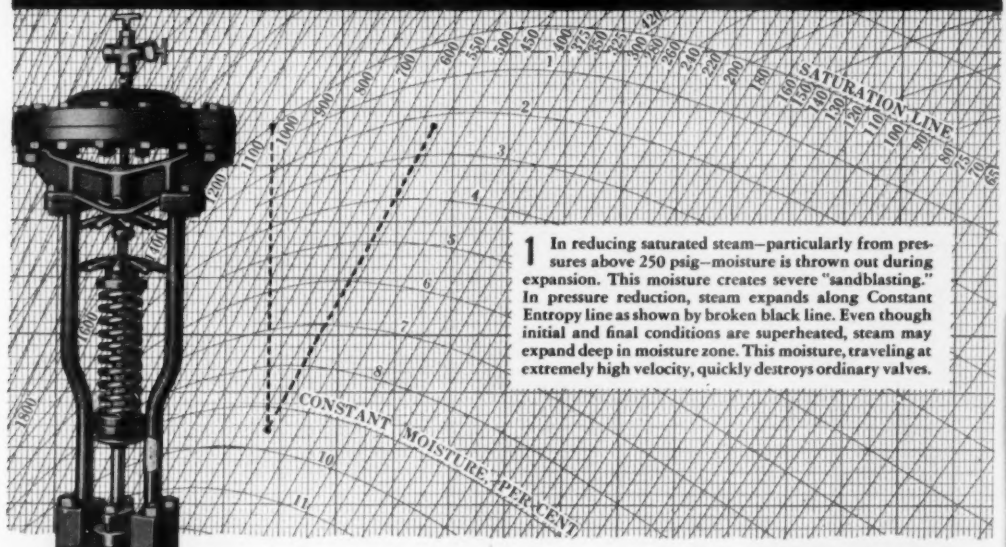
South Plainfield, N. J. — California Spray-Chemical Corp., 150 Bayway, Elizabeth, N. J., insecticides, fungicides, and other spray chemicals, plans boiler house at proposed new plant at South Plainfield, where tract of about 20 acres of land has been secured on Metuchen Rd. Entire project reported to cost in excess of $300,000. Work will begin soon. Main offices are at Richmond, Calif.

Shadyside, Ohio — Ohio Edison Co., Akron, Ohio, has approved plans for new steam-electric generating plant at Shadyside, with generators, high-pressure boilers and auxiliary equipment for large capacity. Entire project is estimated to cost close to $17,500,000, including power substations, transmission lines, and other operating facilities. Project has been approved by Defense Production Administration and work will proceed at early date.

Shiremanstown, Pa. — Gunnison Homes, Inc., New Albany, Ind., prefabricated houses and other structures, plans boiler house at new branch plant at Shiremanstown, near Harrisburg, Pa., where tract of about 50 acres of land has been selected. Factory will be used for production of prefabricated military shelters, and is reported to cost over $800,000. Work will proceed at early date.

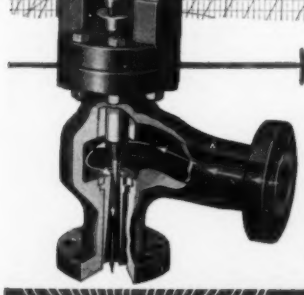
Warren, Ohio — Copperweld Steel Co., Glassport, Pa., copper and bronze wire, seamless steel tubing, etc., plans boiler plant at proposed new factory unit at Warren for manufacture of seamless steel tubing. It will comprise several production units and is reported to cost approximately $8,000,000. Completion is scheduled in 1953.

Swartwout V-10 Flow Regulating Valves slash maintenance costs in systems with high pressure drop or flashing condensate



1 In reducing saturated steam—particularly from pressures above 250 psig—moisture is thrown out during expansion. This moisture creates severe "sandblasting." In pressure reduction, steam expands along Constant Entropy line as shown by broken black line. Even though initial and final conditions are superheated, steam may expand deep in moisture zone. This moisture, traveling at extremely high velocity, quickly destroys ordinary valves.

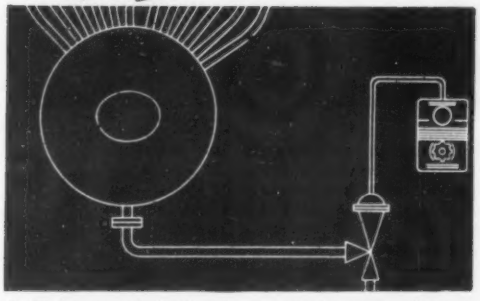
Chart from *Thermodynamic Properties of Steam* by Keenan & Keyes. Reproduced by permission of John Wiley & Sons, Inc., Publishers



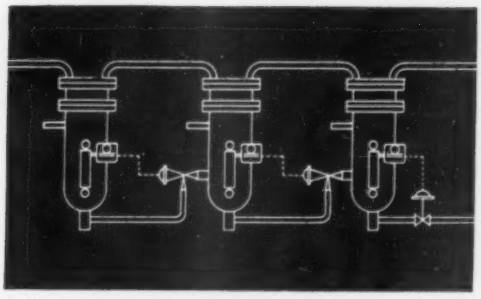
2 Swartwout V-10 valves are scientifically designed to handle liquids at high pressure drops and also under *flashing conditions.* All direct impingement is eliminated and longer valve life is assured two ways—by better flow design, plus use of materials specifically selected for the service involved. As a result, *Swartwout V-10 valves outperform other valves in similar service.*

Swartwout

POWER PLANT EQUIPMENT



3 High pressure boiler blowdown service is extremely rigorous. When closed, there is full pressure drop across valve; when open, high velocities and flashing rapidly increase line loss and decrease the allowable drop across the valve. The variations in pressure make this service critical since valve must handle all conditions.

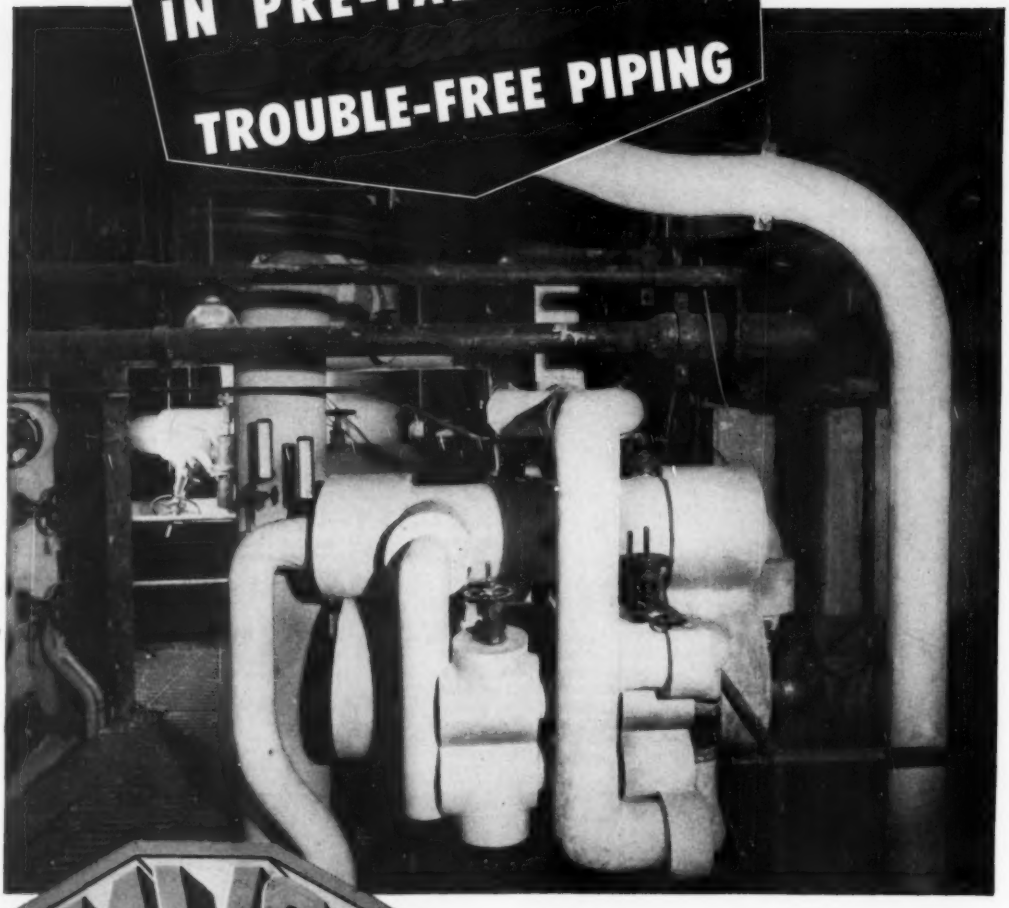


4 In saturated liquid drainage service, such as on high pressure extraction type heaters, water at saturation temperature flashes into steam when pressure is reduced. Exclusive scroll inlet and gradually expanded straight outlet of V-10 valve design permit a sliding action instead of direct impingement thus preventing corrosion-erosion.

A-4206

SEND FOR BULLETIN S-208A • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

NAVCO ACCURACY IN PRE-FABRICATION TROUBLE-FREE PIPING



NAVCO

Prefabrication accuracy is an essential "MUST" to assure a proper fit and economical operation. Navco's 40 years' experience in fabricating assemblies in all sizes and for all operating conditions is your assurance of such accuracy.

Consult Navco for your next piping job.

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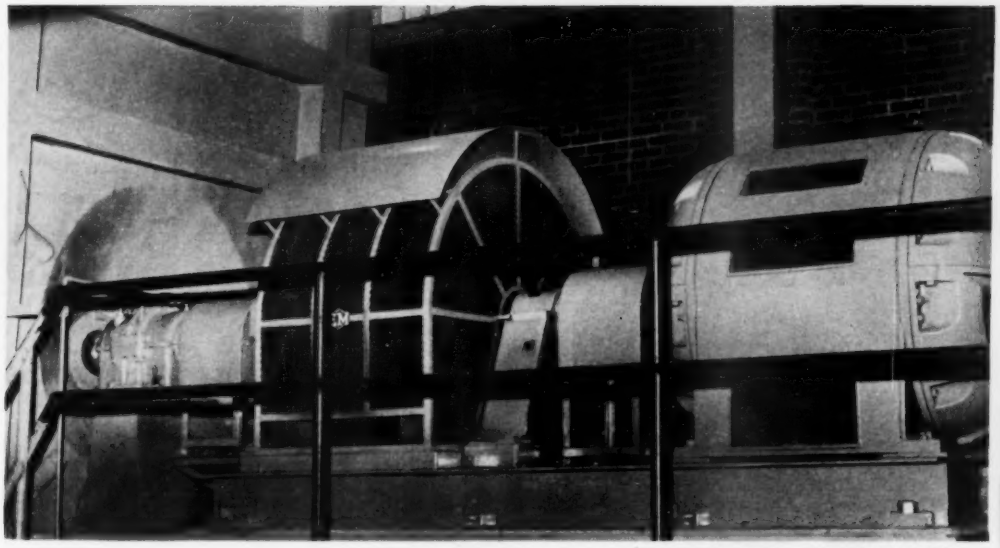


4400-TPA-2118

When You Change Draft Fan Output Do It Quickly...Precisely!

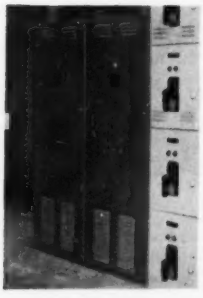
An E-M Adjustable-Speed Magnetic Drive with Regutron Controls gives fast-acting draft fan speed response . . . the quickest, most precise speed control method you can specify for regulating draft fan output to meet varying requirements in your power plant's combustion control system.

At Plant Hagood of the South Carolina Gas & Electric Co. in Charleston, illustrated above, these E-M Magnetic Drives with associated Regutron Magnetic Amplifier Controls respond *unusually fast* to demands for new speeds, altering fan speed in seconds. Special damping and anti-hunt circuits in the "Regutron" Control prevent any overrun on speed changes.

An electromagnetic torque-transmitting device, the E-M Magnetic Drive converts the economical constant speed of an a.c. driving motor into adjustable speed for the fans.

This fast, accurate E-M control of fan speed helps cut down thermal losses and improves combustion. Also, the need for damper controls or inlet vanes on the fans is eliminated. Costly erosion of fan blades is minimized.

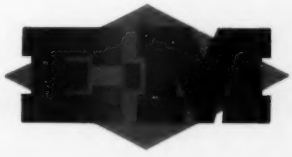
Ask your nearest E-M sales engineer how the Magnetic Drive and Regutron Control can fit in your plant. And write the factory for the publication listed below.



THIS IS THE NEW E-M REGUTRON MAGNETIC AMPLIFIER CONTROL for Magnetic Drive installations. This new simplified control adjusts fan speed accurately to within 0.5% of speed called for by automatic combustion control. A simple saturable core reactor amplifier system accomplishes quick, precise control of speed.

ELECTRIC MACHINERY MFG. COMPANY
MINNEAPOLIS 13, MINNESOTA

☐ Send me Publication No. 1107 on Magnetic Drives and Regutron Controls.



Dependable Auxiliary Drives for Power Plants

8 BOURDON TUBE MATERIALS

MAKE IT EASY TO SELECT THE RIGHT ASHCROFT DURAGAUGE FOR YOUR PARTICULAR NEEDS

- Phosphor Bronze
- S. A. E. 4130X Alloy Steel
- S. A. E. 4650 Alloy Steel
- "K" Monel
- Type 316 Stainless Steel
- Type 347 Stainless Steel
- Type 431 Stainless Steel
- Beryllium Copper

Service conditions and requirements determine what Bourdon Tube material is best in the pressure gauges you buy. To insure sustained accuracy and maximum durability in specific installations, Ashcroft Duragauges are available with Bourdon Tubes *in any one of the 8 listed materials.*

All Bourdon Tubes used in Ashcroft Duragauges are extra-wide—have greater sensitivity to slight pressure change. Pulsating pressures 50% higher than the tube rating remove any possibility of tube "set", and all tube joints are stress relieved after assembly. You can select with complete confidence that your Duragauges will serve accurately under the working pressures and corrosive conditions common to your operations.

Ashcroft Duragauges have other features important to you. The Nylon Movement* outwears all others. Unusually long tip travel assures greater accuracy of indication. The micrometer adjustment pointer can be reset while on the shaft. Precise recalibration of gauges in the field is easy. Sturdy lifetime cases, in a choice of materials, are available for stem, wall or flush mounting.

The nearby Ashcroft Distributor will gladly help you choose the right Duragauges for your particular service.

*Patented

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ASHCROFT GAUGES

MANNING MAXWELL & MOORE

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MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, BUILDERS OF "SHAW-BOX" CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

MORE POWER FOR GREECE

One of the four Detroit Rotograte Stokers of eight feeders each.

DETROIT ROTOGRATE STOKERS TO ISLAND OF EUBOEA

Four Detroit RotoGrate Stokers have been shipped to the Kingdom of Greece. Each Stoker will fire a 200,000 pound per hour capacity unit. Design is based on locally mined low-grade Lignite of 5,000 minimum BTU per pound and 35% moisture, and an ash fusing temperature of 2140° F with preheated air of 325° F. Steam pressure will be 925 psi, at 905° F. TT. The installation is at Aliveri Thermal-Electric Station, Island of Euboea. Design is by Burns and Roe, Inc., Engineers, New York, under supervision of Ebasco Services, Inc.

Detroit RotoGrate, an improved spreader stoker, will burn all grades of Bituminous Coal or Lignite with high thermal efficiency. Controlled turbulence permits higher burning rates per square foot of grate. Reinjection system is rugged, dependable.

Write for Detroit RotoGrate Bulletin.

DETROIT STOKERS have been selected for plants around the world such as in:
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There is a Type and Size Detroit Stoker for Every Industrial Need

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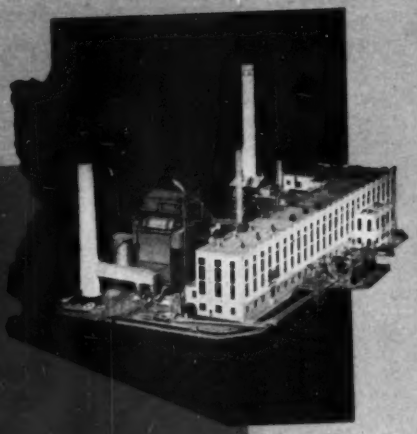
DETROIT STOKER COMPANY

ALSO IN ARIZONA, IT'S YARWAY



PUBLIC SERVICE

PICKS

YARWAY UNIT TANDEMS

FOR 920 PSI BLOW-DOWN SERVICE

Arizona Public Service Company—operating in the youngest, but one of our fastest-growing states—is another prominent utility that relies on Yarway Unit Tandem Blow-Off Valves to guard its boilers. In fact, *4 out of every 5 high pressure boiler plants are Yarway-equipped.*

Such popularity had to be won. It was—by offering good design, careful engineering and manufacturing, modern metallurgy and dependable service.

Yarway engineers, conveniently located near you, are constantly working for better, more profitable steam plant operation. Need help? Call a Yarway man.

YARNALL-WARING CO.
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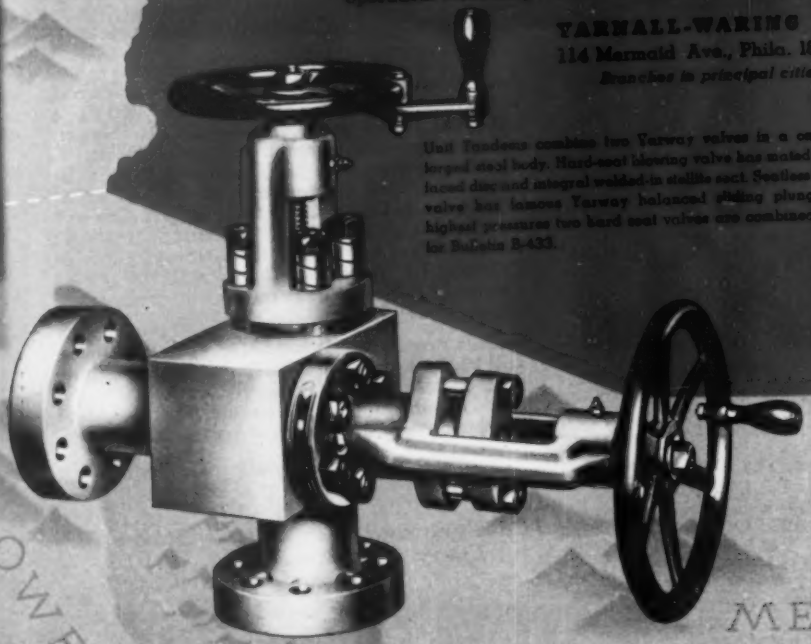
Unit Tandems combine two Yarway valves in a one-piece forged steel body. Hard-seat blowing valve has mated stellite-faced disc and integral welded-in stellite seat. Seatless seating valve has famous Yarway balanced sliding plunger. For highest pressures two hard seat valves are combined. Write for Bulletin B-433.



YARWAY SERVICE GOES ALL THE WAY....

LETTERS TO THE EDITORS

How to Buy Coal

I HAVE READ with great interest the very remarkable article How to Buy Coal, by F. M. Reiter, in the November 1951 issue.

Mr. Reiter should be highly complimented for the clearness, conciseness and completeness with which he expounds a most intricate problem. As far as I am concerned there is not one word I would like to add to, or subtract from, his comments and conclusions.

In our generating station (100,000 kw in two 50,000-kw units) the methods of coal procurement are substantially the same as his. But it may be of interest to readers to know how we present the over-all picture of Btu costs.

It is well known that a good many engineers, and most executives, prefer to look at a picture rather than a table. Accordingly, in our Monthly Rating of Coal, instead of stating the weighted effect of the Btu costs as in columns 13 and 14, Tables I and II, of Mr. Reiter's article, we use the accompanying diagram.

Along the horizontal axis we enter the total content of each coal supplied; total Btu equals Btu per lb multiplied by total lb.

Along the vertical axis are the costs of each coal, per million heat units (line AB on the graph). Thus the area of each rectangle is a measure of the total cost of the corresponding coal.

Coals are listed also in the order of their actual costs per million heat units as received, from the lowest to the highest. The lower curve (line CD) is the integral or weighted cost of all the coals up to that point; so that the last step of that curve is the weighted average cost of all the coals received during the month. By extending this last step right back to the vertical axis at E, it is readily seen what coals were below, above or average, and what was their relative influence in the whole picture.

The units used are, of course, European. So maybe it would be suitable for me to add a short conversion table:

1 dollar = 50 francs (Belgian)
1 kg = 2.2 lb
1 Btu = 0.252 kg-cal
1 Btu = 252 cal
1 kg-cal = 4 Btu
1 kg-cal per kg = 1.82 Btu per lb
1 million cal = 10^6 kg-cal

Belgium — P. VAN HERK

Air Gun for Cleaning

AS A REGULAR READER of your magazine in England, I must hand it to you Americans for the way you pool your knowledge. We on this side of the Atlantic would do well to follow your example with regard to everyday operating matters.

I am just wondering if your power station men know about cleaning condenser tubes with an air gun. The old ramrod and brush method is still used in some places over here but, apart from wasting time, the wire brush often disturbs a natural coating on the surface of the tube (e.g., oxides) and corrosion is accelerated. A gun using brush bullets has the same disadvantage, but an air gun can do the job quicker and better, outage time being reduced to an hour or two instead of half a day.

The gun builds up a pressure of about 2000 psi and discharges in bursts; it just needs to be hooked up to a compressor.

With good wishes from some engineers on this side.

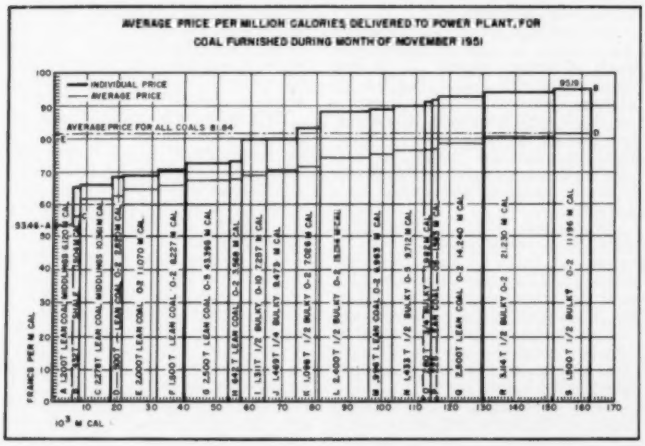
London, England — JOHN P. HAZELL

Editor's Note: — We return Mr. Hazell's good wishes, on behalf of all our readers. Yes, our pooling of technical knowledge is one of the most important factors, we believe, in advancing our power plant and other industrial arts.

Mr. Hazell is an assistant engineer on Power Station Development, Chief Engineers Department, British Electricity Authority, Winsley St. near Oxford Circus, London W1.

Condenser cleaning methods in this country vary. At present there is great interest and activity in cleaning of condensers by chemical methods. Other methods include shooting rubber plugs and brushes and use of mechanical cleaners. We expect to publish more on condenser cleaning in future issues.

Chart by Van Herk showing how his company evaluates various coals in Belgium. Since the chart is intended only to show the procedure, the data, expressed in European units, have not been converted.


AVERAGE PRICE PER MILLION CALORIES DELIVERED TO POWER PLANT, FOR COAL FURNISHED DURING MONTH OF NOVEMBER 1951
INDIVIDUAL PRICE
AVERAGE PRICE
AVERAGE PRICE FOR ALL COALS 81.84
FRANCS PER M CAL
10^3 M CAL

Do You Want To Be a Technical Editor? — Once again a position is open on the editorial staff of POWER ENGINEERING for a qualified assistant editor. If you are a young man with technical background and writing ability, our progressive 56-year-old organization may be the place for you.

Preferably you should be 25 to 35 years old, with a bachelor's degree in mechanical or electrical engineering. Degree or not, you should have at least 2 or 3 years' practical work in industry, handling (or very familiar with) boilers and firing equipment, turbine generators, auxiliaries, and in touch with general power plant design, operation and maintenance.

Your experience should be primarily in steam engineering, although you must also know something of electrical work. You should know something about technical writing and show evidence of aptitude for technical editorial work.

As a member of our staff, you will have one of the most interesting careers in America today. You will be in close contact with the ever-expanding $50,000,000,000 power industry; you will associate with the finest group of men alive, the power engineers; you will acquire a broad picture of American affairs that few others possess.

If you are interested, write The Editor, POWER ENGINEERING, 110 S. Dearborn Street, Chicago 3, Illinois.

Fig. 1. View of Oak Creek Station, under construction by Wisconsin Electric Power Co. It will have initial unit of 120,000 kw capacity, ultimately four units

OAK CREEK . . .

New and Different

WISCONSIN ELECTRIC Power Company's new Oak Creek Station, on the shore of Lake Michigan 10 miles south of Milwaukee, will have four 120,000-kw units when completed. First unit is scheduled to go into operation early in 1953, according to O. J. Stallkamp of Wisconsin Electric in a paper given at the American Power Conference, from which the following data were adapted.

Built partly into a bluff, the plant's personnel entrance will be at the top floor of a 6-story service building. This structure will house electrical control room and shops, offices, laboratory, class room, lunch room, locker rooms, mechanical shops and storage rooms. Wisconsin winters forbid outdoor construction with the exception of induced draft fans, dust collectors and breechings. Functional building design, a minimum of windows and skylights, and turbine and boiler rooms sided with corrugated asbestos concrete are in construction plans.

Oak Creek, in addition to features found in the system's Port Washington and Lakeside stations, will have cross-compound turbines, controlled circulation boilers, vertical pumps, pressurized circulating water tunnel and centralized control.

First cross-compound turbine generator, built by Allis-Chalmers, will consist of a 3600-rpm, 80,000-kw, high-pressure, intermediate-pressure unit and an 1800-rpm, 40,000-kw, double-flow, low-pressure unit, as shown in Fig. 2. Generators will function as a single unit. Cross-compounding secured advantages of each and obtains the most economical balance of investment and operating costs.

Oak Creek's First Unit

The unit is an impulse-reaction type with reheat and 6 extraction points for feedwater heating, and is designed for a throttle pressure of 1575 psi at 1000 F, 1000 F reheat and 0.5-in. back pressure.

Specification of low back pressure was possible because of Lake Michigan's abundant supply of cooling water. Water at Oak Creek has an average temperature of 46 F and is constant and unlimited in supply, non-corrosive, clean and requires little chlorination. Large exhaust blading flow area and condensers plus efficient pumping will exploit this advantage.

Single-pass, 30-ft inhibited Admiralty tubes will be used in the first condenser, built by Allis-Chalmers. Shell, water boxes and tube sheets are steel. Two vertical condensate pumps, set in the floor by the condenser, and two steam jet pumps for air removal will be operated remotely. Rupture discs will be used instead of atmospheric relief valves.

There will be a separate pump house with trash bar screen and three 10-ft wide travelling screens. Four 96-in. by 72-in. vertical axial-flow pumps, each driven by a 700-hp motor, will discharge under pressure to a common tunnel supplying four condensers. Tunnel velocity of 7 fps and streamlining will reduce flow resistance and lower pumping head to 17 ft. The tunnel, gravity-type, is arranged for re-circulation to prevent winter icing.

Pump house also will contain four 2000-gpm (70 psi) vertical service pumps and two 500-gpm (200 psi) booster pumps for special use. Discharge-side strainers will facilitate quick purge back-washing. Service water piping, valved so extensions and repairs can be made easily, is planned as a dual system of half-size pipe.

Half of service water pump capacity is provided for cooling turbine and transformer oil, but most of the year condensate can be used. Griscom Russell double tube sheet coolers in pairs, one cooled by service water, the other by condensate, will divide the cooling job.

Fire hazards will be reduced by isolation of transformer oil circulating pumps, coolers and piping in a sump. Turbine lubricating and oil relay system will be protected by steel fittings, welding, water sprays and elimination of the continuous bypass open oil filter.

A single boiler, operating at 1750 psi with controlled circulation, will

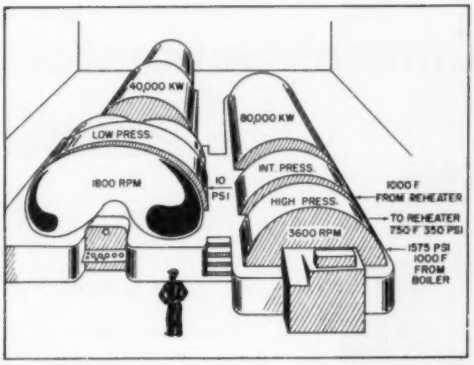


Fig. 2. Artist's sketch showing relative size and arrangement of Oak Creek's 120,000-kw cross-compound turbine generator

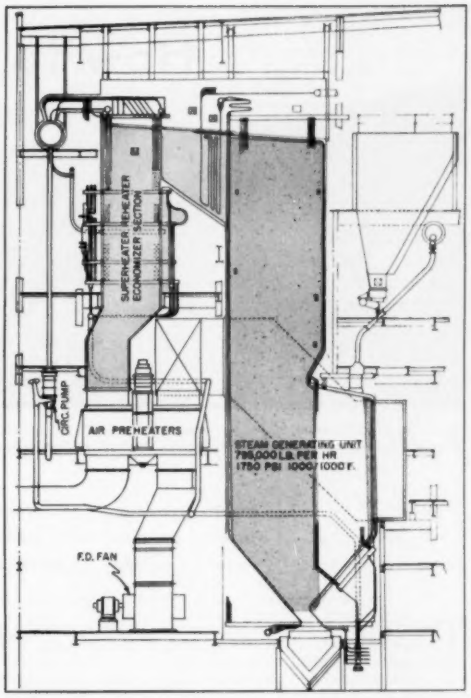


Fig. 3. To insure adequate circulation of water in predetermined quantities, Oak Creek's boiler will use 2 of 3 single-suction constant-speed motor-driven pumps to raise pressure 50 psi and circulate water from the drum to heating surfaces

supply a single turbine. There will be no piping between future units for main steam, reheat steam or feedwater.

First boiler, designed by Combustion Engineering-Superheater Co., Fig. 3, will have three 3500-gpm single-suction constant-speed pumps (one of which is a spare), driven by 200-hp motors, to raise pressure 50 psi and circulate water from the single drum to various heating surfaces. Circulation rate will be four times steam-generation rate. Waterwall and other heating tube orifices of predetermined size will control the amount of water to heat transfer.

On the furnace's back wall, the primary radiant superheater is connected in series to a primary convection superheater. In series the two superheaters, built by Foster Wheeler Corp., will produce practically constant outlet temperature. Radiant reheaters form the furnace's side walls. Furnace volume (120,000 cu ft) and heat release (10,000 Btu per cu ft max) will limit furnace temperature to reduce slagging.

Two Ingersoll-Rand 10-stage half-capacity boiler feed pumps will be driven by 1500-hp Westinghouse constant-speed motors with feedwater flow regulated by Bailey 3-element controllers.

Two duplicate 64-gpm Cochrane demineralizers will be used to serve all 4 units and provide for 2 per cent max make-up. Normal make-up is expected to be 40-gpm. Four large sand filters will condition lake water and supply a 26,000-gal overhead tank serving softeners, back-washing filters, etc.

Main steam piping from primary superheater outlet to turbine throttle will be 15½-in. OD, forged and bored steel alloy. There will be two intercepting valves and two dump valves — no stop valve. No bypasses will be used for warming up.

Fuel and Firing

Midwest coal shipped from South Chicago ports will be piled on an 810,000 sq ft dock built into the lake. Self-unloaders will deposit most of the coal next to a belt conveyor, but scrapers, bulldozers and portable conveyors are planned for stocking and reclaiming. The belt conveyor will carry coal to weighing stations and silo bunkers. The four units will burn about 1,500,000 tons per year.

Each of two Raymond roller mills will pulverize coal at 25 tons per hr, after which it will be separated and transported by compressed air to a 500-ton bin. Eight duplex feeders will serve 16 fan-tail burners firing through an arch of the front water-wall tubes. Control of superheat and reheat temperatures will be maintained by differential firing into 4 semi-cells formed by three partition walls of tubes below the front-wall arch.

A provisional number of soot blowers will be installed. Ash from furnace bottoms will be handled by vacuum conveyor using water-operated injector nozzles. Ash and dust will be held in silos for sale or disposal.

Placing turbine and boiler control panels on the same level was a structural impossibility, but controls for units 1 and 2 will adjoin each other as will controls for units 3 and 4. Centralized control will employ monitoring of bearing temperatures to reduce policing, anticipation of trouble by alarm systems, visible recording instruments, and convenient and clear communication.

Generator voltage is 13,800 and generators will be direct connected by bus duct to a 145,000-kva GE transformer to step up voltage to 132,000. A 10,000-kva auxiliary transformer will be tapped off generator leads to supply 4160-v plant auxiliary service, and a similar transformer will step down voltage to 4160 v from the 132,000-v bus.

Load center sub-stations with duplicate transformers will step down 4160 v (for motors larger than 150 hp) to 480 v (for motors of less than 150 hp). Cabinetrol stations will be used for smaller motors.

Two exciters, driven by the low-pressure turbine, and a motor-driven starting exciter with automatic control of voltage will provide excitation for the generators.

How to Control Generators in Parallel

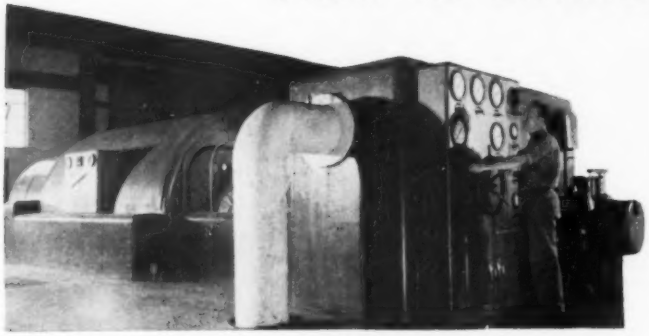


Fig. 1. This 15,000-kilowatt, 80 per cent power factor, 12,500-volt generator is the most important unit on a small Midwestern power system. Its "Regulex" control is mounted in basement below the generator

By H. D. TIMM,

Engineer, Allis-Chalmers Mfg. Co.

Rotating voltage regulators, properly applied to modern power systems, now provide accurate control of the reactive current supplied by each synchronous machine

TODAY one of the most interesting fields of application of rotating regulators is so called voltage regulators. Actually these generator controls are more than the name implies, for they serve as coordinating devices for tying generators into a generating system. The modern voltage regulator assures proper division of reactive load, prevents the generator under control from being overloaded with wattless current, eliminates the dropping of the generator load due to improper excitation and compensates for voltage drop in lines and transformers.

A voltage regulator is known as astatic when the voltage remains constant and independent of the load. This is represented graphically at (a) in Fig. 2 (A). A regulator is called static when the regulated quantity acquires different values dependent upon the variable quantity. This condition is shown at (b), Fig. 2 (A). Both these characteristics have a definite place in regulator operation.

All regulators require some change in the regulated quantity to initiate action. The sensitivity of the measuring element is the amount of change required in the regulated quantity before regulator action is initiated. In mechanical regulators, the sensitivity is dependent on the friction in the device; in regulators without moving parts it is dependent on the "trigger action" or the steepness of the characteristic of the sensing unit. In a graph such as Fig. 2 (A) the band of insensitivity is represented by the width (c) of the regulator characteristic line. A specification will often read, "The regulator is to have a sensitivity of plus or minus one per cent." What is meant is that the regulator is allowed to have an insensitivity band of two per cent or plus or minus one per cent from the mean. Most modern regulators for larger alternating-current machines have a sensitivity within plus or minus one-half of one per cent.

The term sensitivity is often confused with accuracy. The inaccuracy is the total variation of the regulated quantity over the entire regulating range. This is represented by (d) Fig. 2 (A) and would include any static droop which might purposely be designed into the regulator. If the regulator characteristic should include irregularities as shown at Fig. 2 (B), the inaccuracy includes the over-all band of all such variations. It is therefore obvious from Fig. 2 (A) that with an astatic regulator, as represented by band (a), the sensitivity and accuracy are the same. That is why this characteristic is preferred on voltage regulators and altered only when required to accomplish control functions.

Astatic Characteristics

The astatic characteristic (a) in Fig. 2 (A) which gives the best accuracy is inherently the most unstable. A small change in the regulated quantity unbalances the regulator producing a corrective signal until the regulated quantity is returned to its correct value. With a perfectly astatic regulation curve, a small change in the regulated quantity would produce a 100-per cent change in the variable quantity. Obviously, therefore, when regulators are designed to give the best accuracy, other means such as damping and stabilizing circuits are necessary to give stability.

In contrast, the static characteristic (b), Fig. 2 (A) is inherently stable as a small change in the regulated quantity gives a relatively small change in the variable quantity. As the regulator moves over its operating range, the value of the regulated quantity at which it balances is changed. Normally, this value droops with increase in load.

In the modern voltage regulating scheme the regulator is part of a closed-cycle system as shown schematically in Fig. 3. In this system a measure of the alternator output voltage is fed back through the measuring and adjusting circuit and is amplified through the five stages consisting of the comparator, the two exciter stages, the main exciter and the alternator. The system operates to control the alternator output voltage.

With the high gain or amplification from the comparator to the main exciter, a very slight deviation from the balance point of the comparator gives a trigger action to change the main exciter voltage from the no load to the full load point. Thus the small deviation in the regulated voltage required to give full regulator action establishes the astatic regulator characteristic under straight voltage control as shown at (a), Fig. 2 (A).

The factors in operation that make it necessary to diverge from straight voltage regulation are as follows:

(1) Reactive current compensation with parallel operation of alternators

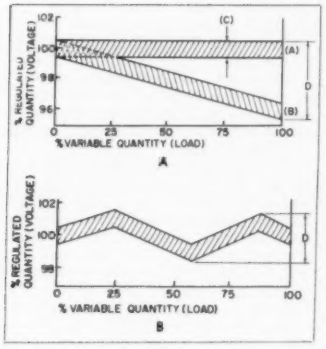


Fig. 2. Accuracy is affected by static droop, sensitivity by the change before regulation begins

(2) Line and transformer drop compensation

(3) Current limit and thermal protection for synchronous condensers

(4) Minimum excitation limit for synchronous condensers and stability control of generators.

Accurate Regulator

When an accurate voltage regulator controls the excitation of an alternator connected in parallel with other regulated machines, regulator operation controlling the alternator field has no appreciable effect on the real or kilowatt load. The real load is adjusted by changing torque on the alternator shaft and is controlled by the action of the speed governor on the prime mover. Changes in field excitation under the action of voltage regulators affect only the reactive or wattless component of the alternator output.

The wattless component in any power system is the excitation required for synchronous and induction machines and magnetic circuits such as solenoids on the system. The alternator, unlike the self-excited d-c generator, does not necessarily supply the correct self-excitation for the voltage delivered at its terminals. If it is under-excited it draws a leading current from other alternators or capacitors on the system. This current is leading when viewed from this machine, but is lagging when viewed from the position of the other machines on the system which supply it. The amount of this leading current represents the deficiency of the alternator to supply its own required excitation.

If the machine is over-excited, it supplies both its own excitation and wattless power required for the excitation, or magnetization, of other apparatus on the system which cannot or does not supply its own exciting current.

This can be explained further by reference to Fig. 4. Figure 4 (A) shows a one-line diagram of two duplicate alternators operating in parallel on an infinite bus and Fig. 4 (B) shows their vector relations at unity power factor with reference to the external circuit. An infinite bus is one fed by a power system sufficiently large that the bus voltage will not be changed appreciably by the individual generators connected to it. In this diagram the alternator reactances (x) are assumed equal and E_1 and E_2 are considered as the internal induced electromotive forces.

In this parallel circuit with the external voltage V held constant by other generators on the system, V_1 and V_2 are equal. I_1R_1 and I_2R_2 are equal since the currents are assumed to be equal. I_1 and I_2 add up to the in-phase current I′ delivered by the two machines. Voltage regulators control the excitation of both alternator No. 1 and No. 2.

machines in phase with the terminal voltage V.

To prevent circulating current between the two machines without equalizing means when both generators are under regulator control, the alternator is given a static voltage droop with increased reactive load. Referring to Fig. 2 (A) the regulator is made to function according to characteristic (b) where the regulated quantity is voltage and the variable quantity is reactive or wattless load.

Regulator literature is confusing when referring to a voltage droop with the condition where a generator under voltage regulator control is tied to a system. Normally, the voltage cannot be made to vary substantially by means of the regulator because the capacity of one generator is usually small compared to the whole

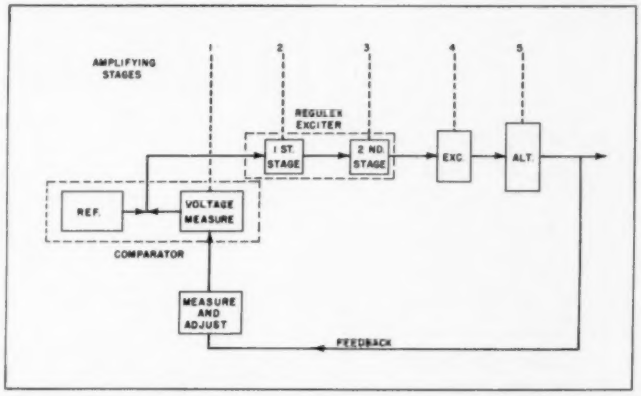


Fig. 3. Modern voltage regulators form a closed cycle system. A sample of the generator output is fed back into the amplifying chain and modified with a static droop or rise for the additional functions required for the control of generators operating as part of a generating system. This is clearly illustrated here

It is not practical to set two voltage regulators to hold identically the same voltage and keep the setting under all conditions without equalizing means. The case is similar to the equalizing required between two compound wound d-c generators in parallel or between two speed governors controlling the power to two prime movers.

If, for example, these two units with equal regulator settings are put on the line at the same time and the heating of the elements of one regulator is faster than that of the other, it will temporarily try to regulate for a higher voltage, and will move its excitation to a maximum. The resulting condition is shown vectorially in Fig. 4 (C) and a circulating current I_0 will flow between machines, leading in machine No. 2 and lagging in machine No. 1. Although it produces no real power I_0 causes unnecessary heating of the machine because I_1 and I_2 must be larger to give the same total value I′ which is the summation of the currents in both

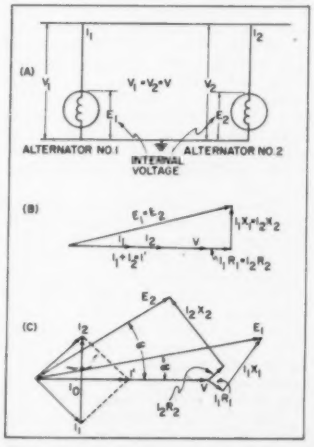


Fig. 4. A voltage regulator in reality is a wattless current control when the generator being controlled is connected to an infinite bus as illustrated here

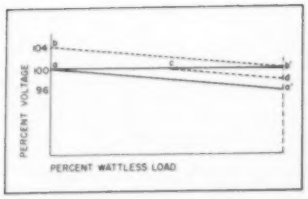


Fig. 5. The static droop of the regulator in the circuit above prevents the generator from taking more than its share of wattless load. Real watt load is controlled by the prime mover governor

system. Under system operation, the term droop is only illustrative, because, as explained by Fig. 4 the change of excitation by the regulator is a regulation of the 90 degrees or wattless current. Actual voltage regulation is obtained only when a generator is not connected to a system.

A better understanding of this point can be obtained by reference to Fig. 5. In this figure voltage is plotted against wattless current. Suppose the regulator is given a 4-per cent droop with wattless current. If the regulator could change system voltage, increase in wattless current would drop the voltage from 100 per cent at no load along the line a-a′. If the regulator voltage setting is raised 4 per cent by means of the voltage adjusting rheostat from 100 per cent at no load, the voltage line is moved from a-a′ to b-b′ and 100-per cent wattless load is picked up at point b′. In this change the system voltage remains on line a-b′.

Ideal Conditions

Furthermore under ideal conditions, if 100-per cent voltage is obtained at no load and the real or watt load is increased by throttle opening, watt current is picked up and the locus of operation in Fig. 5 is from a to c in going from 0 to 50-per cent watt load. In this case, as watt load is increased from zero, the generator will start to draw a leading current from the system due to under-excitation. The reactive compensation will act in the boost direction to keep the regulator substantially astatic from a to c. At point c automatic regulator operation is along line c-d.

If at point c with 50-per cent watt load the regulator voltage setting is increased such as to make the generator assume full rated kva load, the regulator characteristic changes from c-d to b-b′. Under this condition, the generator has 50-per cent wattless current and 50-per cent watt current, with a drooping characteristic with increased wattless and a rising characteristic with a decrease in wattless for parallel operation.

Therefore it is important to note that, with a voltage regulator in operation on a generator, the control is astatic with real load and static with reactive or wattless load.

Further understanding of reactive load division between generators when the generators are under the control of regulators and are connected to an infinite bus, is given by a consideration of the three-phase relations as pictured in Fig. 6. The point of view should be directed from (a) from which point the circulating current I_0 as explained under Fig. 4 is leading in generator No. 1 and lagging in generator No. 2. In this figure a simple regulator is shown with the single-phase voltage control taken from phase AC and the reactive current measurement taken from current transformers in line B. The three-phase voltage and current

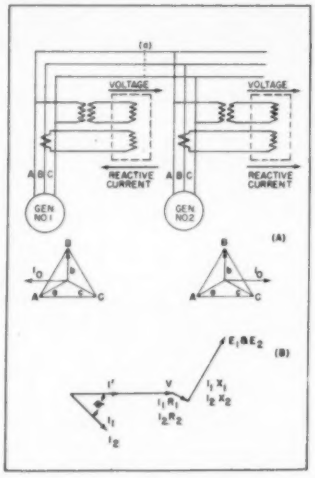


Fig. 6. Reactive current compensation ends objectionable circulating currents between generators

relations are shown at Fig. 6 (A) for the two machines, and the reactive component I_0 adds to the voltage of regulator No. 2 and subtracts from the voltage of regulator No. 1. Under automatic control in a closed-cycle system the voltage applied to regulator No. 2 would appear too high because the reactive component adds to the voltage and the regulator would move to reduce excitation. Similarly, the voltage applied to regulator No. 1 would appear too low and the regulator would move to increase excitation. Referring to Fig. 4 (C) the circulating current I_0 will be reduced to a minimum, both machines will carry equal share of reactive current, and the condition of Fig. 6 (B) will prevail.

When used with the voltage regulator the device used to accomplish reactive current division is known as the reactive current compensator.

The reactive current compensator consists of a bridge between a high impedance autotransformer (A) and two low impedance reactors (B) as shown by Fig. 7 (A). Its output is inserted in the center leg of the three phase open delta circuit between the voltage measuring potential transformers and the voltage adjusting control (C). The isolating transformer allows independent grounding of the potential and current transformers. The compensator as applied to the regulating system is also shown at (1) in Fig. 8.

The voltage and current relations at the synchronous machine terminals are shown in Fig. 7 (B) and the current OX measured by the current transformer consists of the in-phase component OB and the reactive component OB′. At unity power factor when the reactive component OB′ is zero, the current is represented by the vector OB only. When the sum of these components is translated to voltages of the proper magnitude by the autotransformer, reactors, and isolating transformer and inserted in the comparator circuit the effect is to vectorially add to or subtract from the AB and BC sides of the three-phase voltage triangle and thereby change the three-phase voltage to the comparator.

Current Transformers

A characteristic of current transformers is that the current in the secondary is a true measure of the current in the primary, and the current in the secondary is directly in phase with the primary current. However, the voltage in the current transformer secondary depends on the impedance of the load in its secondary circuit. In this case the current through the compensator at unity power factor is in phase with the current OB. However, the voltage 1–2 and also P1–P2 which is applied across the isolating transformer from a purely reactive current transformer

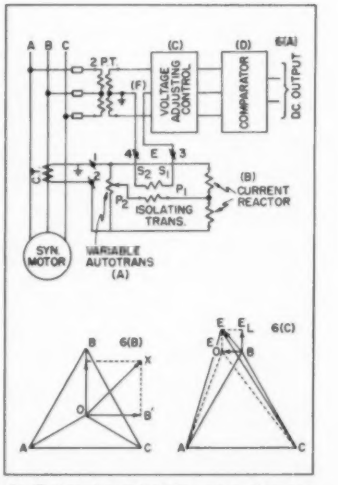


Fig. 7. Manual control of the amount of reactive current compensation is provided with a variable autotransformer. The compensator modifies the signal of the voltage adjusting circuit as shown here

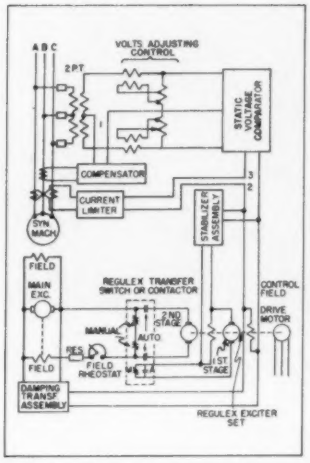


Fig. 8. Reactive line drop compensation operates the same as reactive current compensator except the output signal of compensator is reversed

secondary load, leads the current by 90 degrees. As shown in Fig. 7 (C), the compensating voltage at unity power factor with full load current when inserted in the comparator circuit at (F) appears as BE_O. At unity power factor, addition of vector BE_O is increased correspondingly above CB and the average three-phase voltage remains substantially the same. The reactive or wattless component will produce a voltage which lags the vector BE_O by 90 degrees and causes it to rotate clockwise as the power factor decreases from unity in the lagging direction. At zero power factor lagging it will have the position BE_L and the wattless component will add directly to the average three-phase voltage. The resultant voltages transmitted to the comparator at (F) ahead of the voltage adjusting control (c) are AE and CE at normal load power factor and the over-all increase in voltage is proportional to reactive current only.

Small Droop Required

Normally, not more than five percent droop with increased wattless current is required at full load to cause adequate division of wattless current between alternators. The voltage BE is approximately five per cent of the three-phase voltages measured by the potential transformers. The vector proportions shown in Fig. 7 (C) are exaggerated for the sake of clarity.

With the comparator adjusted for a certain voltage, the addition of voltage BE, Fig. 7 (C), measured from and in proportion to reactive load, makes the comparator voltage too high for its adjustment, and it instigates an output to reduce excitation. This provides a decrease in the machine internal voltage with increase in reactive current and gives the regulator a droop with increase in lagging wattless current. Thus two or more generators can be made to operate in parallel with proper division of reactive current in proportion to their capacities.

When a generator is operating on a power system, it is often desired to keep a constant voltage at a distribution point some distance from the generator. With transformers between the generator and the distribution center, the generator voltage must increase with load current to overcome the reactive and resistance drop of the transformers and the line. The voltage relations with reactive load are shown in Fig. 9 (A) where the voltage E_1 is required from the generator to overcome the resistance and reactive drops RI and XI respectively and maintain the voltage E_2 at the load center. With a regulator in operation from the generator terminals, the distribution center voltage E_2 can be maintained constant under all conditions. Both the RI and the XI drops can be compensated for if required, but in most cases the RI drop is small enough to be neglected and the XI drop only need be considered.

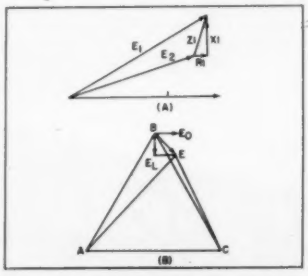


Fig. 9. Voltage drops to the first point of distribution on the system are offset by drop compensation

The reactive line drop compensator is a mechanical and electrical duplicate of the reactive current compensator used for division of reactive load between alternators in parallel. The only difference required is that the generator be given a rising voltage characteristic with increasing reactive load rather than a drooping characteristic as is the case with alternators in parallel.

The rising voltage characteristic is accomplished by the simple expedient of reversing the compensator output as applied to the comparator by reversal of the outgoing leads connected to terminals 3 and 4 as shown at E in Fig. 7. When applied to the measured voltage with this connection the compensator action reduces the three-phase average voltage (ABC) which is presented to the comparator to AEC. This is illustrated at B, Fig. 9.

Considering that the regulator is adjusted with a definite setting, an increase in reactive load will make the voltage to the comparator appear too low. The value of the voltage reduction will be a measure of the XI drop in Fig. 9 (A). The comparator will produce an output to raise the generator voltage to the value E_1, Fig. 9 (A), giving the voltage E_2 at the distribution center.

The above description is practical with one machine in a station where it is only necessary to compensate for the drop between its terminals and the distribution center. If there are two or more machines in a station, there must be reactive compensation for proper parallel operation between alternators and in addition the bus voltage must be given a rising characteristic to overcome drop between the machines and the distribution center.

Line Drop Compensator

When parallel operation and line drop compensation are both required in a station one means of connecting the compensators is shown in Fig. 10. The reactive current compensators are connected at the machine terminals as shown at A. The line drop compensator measuring the combined reactive current from the two machines is shown at B. The output from the line drop compensator and the reactive current compensators are connected in series to effect the respective comparators at the voltage adjusting controls.

The line drop compensator gives an equal voltage rise to each machine with increased reactive current to maintain the correct voltage at the feeder, or to the distribution point by compensating for line and transformer drops. Equal division of reactive current between alternators is maintained by the reactive current compensators.

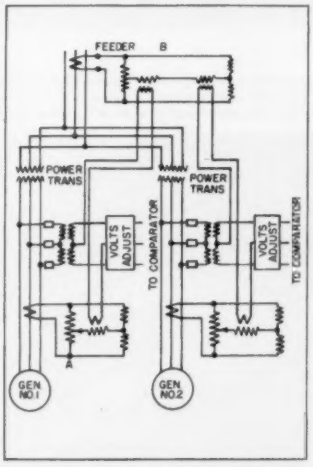
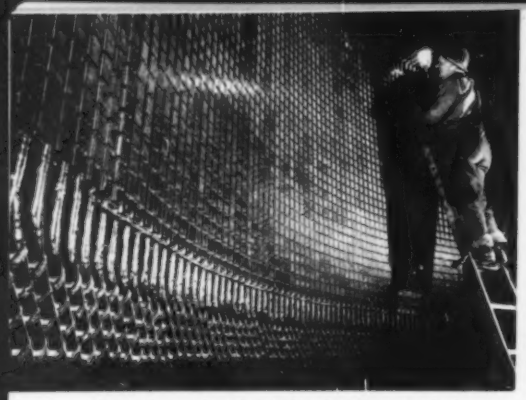
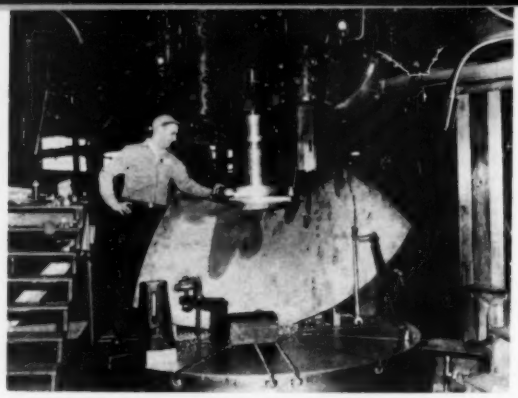


Fig. 10. Both parallel reactive current compensation and line drop compensation can be provided



Millwright Foreman Fred Eyer checking the alignment of the huge generator stator section of the first General Electric 71,250-kw unit at the Bureau of Reclamation's Hungry Horse Dam in northern Montana



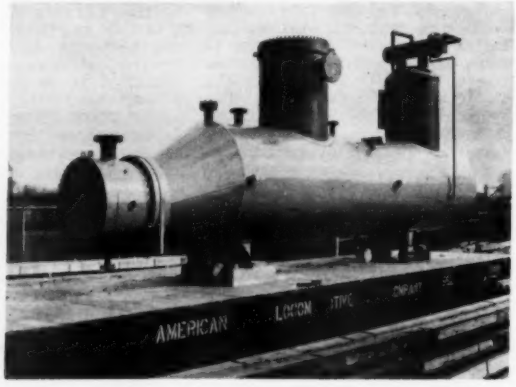
Machining the all stainless-steel trunnion of a Kaplan turbine for the Nangal Hydroelectric Project in the shop of Baldwin-Lima-Hamilton Corp., builders of the four 33,500-hp, 166.7 rpm, hydraulic turbines for this development in the East Punjab

Rotor of one of three steam-turbine generators which the G.E. Co. is building for the California Power Co's new steam plant at Highgrove, Calif.

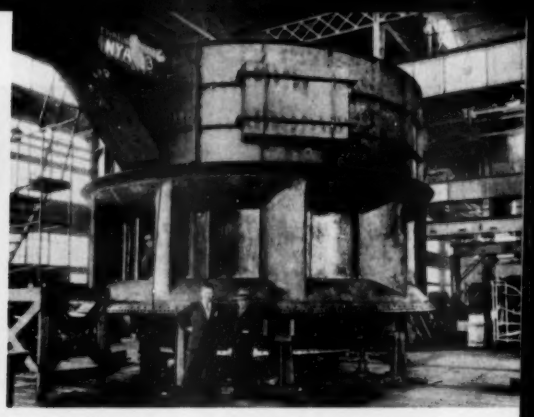
Power Engineering

No, this isn't a roller coaster but a B. F. Goodrich rubber beltroad which transports coal at 350 tons per hour from a mine to a large steam generating plant on the banks of the Kanawha at Glasgow, W. Va.

Feedwater evaporator, made by American Locomotive Company for the removal of minerals from water used in making steam. Lake and river water pure enough to drink is full of mineral matter which greatly shortens the life of high pressure boilers



When this $42,000,000 British hydroelectric, Owen Falls project on the White Nile River is completed, it will supply power to industry in the British Protectorate of Uganda and will also benefit the entire Nile Valley, including Egypt and the Sudan



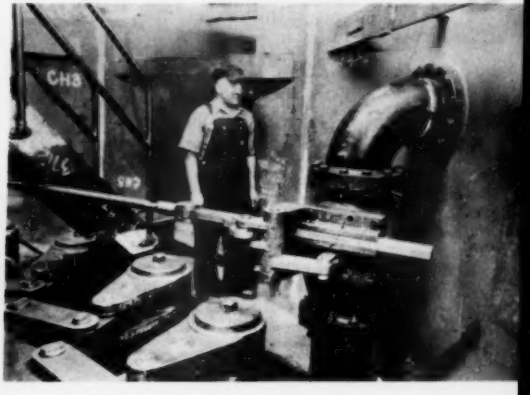
Stay ring, turbine gates and operating mechanism assembly for one of the six 62,500 horsepower turbines built by the Baldwin-Lima-Hamilton Corporation for the Corps of Engineers' Wolf Creek plant in Kentucky

NEWS REEL

Pat Melarkey of General Electric points out the nylon components that go into a ½-hp model of their new Form G fractional-horse-power motor

The Milesburg Station of West Penn Power Company is "semi-outdoor" in design for minimum investment and the greatest flexibility. Trash rack on water intake, outdoor switching equipment, and the coal-handling facilities are all visible in this picture

Testing air admission valve which reduces motoring power of hydro-electric generator when it floats on line as synchronous condenser. One of six built by Baldwin-Lima-Hamilton Corp. for Wolf Creek



Steam Turbine

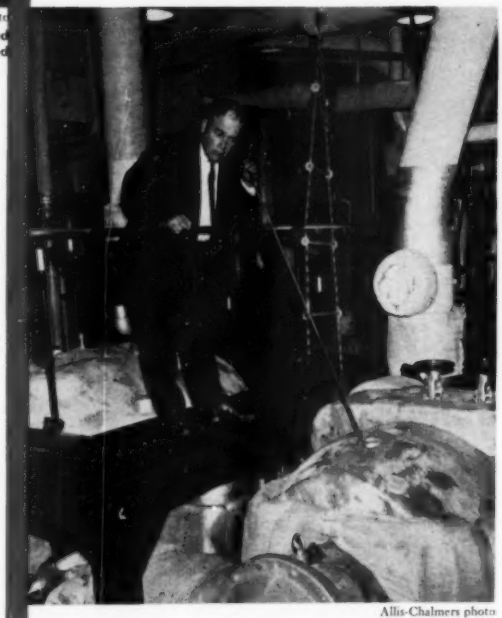
While turbine is operating, full information on performance variations helps you greatly to cut maintenance costs, prevent high-cost outages. Here's how you should make routine capacity tests, proper logs, vibration analysis and lubricant checks. These help in learning when the unit must be dismantled

By C. W. BELL, Sr.

Engineering Consultant

Westinghouse photo

Fig. 1. Tracking down vibration with a portable vibration meter. Inertia-mounted dial indicator and illuminated-dial expanded-scale indicator often used



Allis-Chalmers photo

Fig. 2. To listen for rubs in a turbine, operators should use listening rods systematically. This is a marine turbine but method is same for stationary units

FIRST STEP toward preventing maintenance trouble and expense is to select critically every unit of new equipment purchased.

Next step in an intelligent preventive maintenance program is to know accurately the operating characteristics of each piece of equipment.

Bench Mark or *Bogey* data need to be compared with log records every day. Causes for deviations from normal need to be determined quickly and evaluated, so as never to overlook a dangerous trend. When the deviation represents only loss in economy, it is always easy to decide how much loss can be tolerated.

To let equipment run to the point of actual major failure never pays. Loss of use usually dictates this; but actual failures often result in repair costs many times that of the needed preventive measures.

Equally important is to keep informed on the internal physical condition of units of equipment as determined by detailed inspection, and to have a written record of it, including estimates of when specific new parts will be required.

Ability to evaluate with fair accuracy many indications of deterioration in equipment can readily result in a good availability record where otherwise much high-cost outage may be incurred.

So far as possible, the following suggestions center on the use of methods and devices available continuously to most operating crews. Some situations may require special elaborate tests or investigations to help decide maintenance questions but these do not occur frequently.

These suggestions apply more pointedly to rotating equipment than to static devices and equipment; but the same general principles are applicable there also.

Suggestions are made for recognition of specific signs of distress or deterioration during operation and pointers are given on finding hazardous conditions during internal in-

Preventive Maintenance

spections. Even where exacting processes demand the acceptance of considerable risks, such risks should be evaluated as accurately as possible. Actual failures cost too much.

The aim here is to suggest methods of approach which may be applied, with suitable variations, to fit into a wide range of situations.

Steam Turbines

Routine Tests: — During operation routine capacity tests should be conducted as an all-over check on the ability of the unit to carry its normal load. This is a direct indication of its internal operating condition.

The writer prefers the *Standard Condition* type of test, which is conducted with pre-determined inlet valve position, or number of inlet nozzles active, with uniform steam pressure, temperature, back pressure and extraction conditions, all to be at values that can be reproduced any time in the year. For test purposes, zero extraction is best. A frequency of 4 to 6 tests a year is recommended. Form of test report given on page 94.

By-product of such tests shows up in a general check on meters and gages, since all off-standard values would be double checked before drastic maintenance work is started. In this the first step is to re-calibrate instruments directly involved.

All test readings should be entered on a three column form: *This Test — Last Previous Test — Test After Last Overhaul.*

The figures obtained on a clean machine become bench marks for checking all future variations in performance and are therefore of extreme importance and must be accurate. Freshly calibrated instruments are called for. Since a majority of these will be the regular operating devices, they should be installed to meet ASME Power Test Code practice.

In cases where a single unit operates isolated, particularly on variable load, the above method may not be usable. Under these conditions, meters and other instruments become the sole means of checking unit performance both as to economy and ability to carry load. Their calibration then merits preferred attention to keep them in first class operating condition.

Test Results: — A serious condition in one stage of a multi-stage turbine may show up as a relatively small deficiency in over-all performance, therefore these figures must be examined critically. Any apparent deficiency should be double checked and traced to its true origin.

Log Sheet Records

Any unit has its own *natural* operating characteristics as expressed by its operating instruments. These instruments should always be kept in good calibration so that any irregularities can be detected by comparison with previous *bench mark* values. Log records kept carelessly, or readings from inaccurate instruments, are misleading and the effect may be worse than having no records at all.

Variations in pressure in the cavity after the first stage wheel, of a multi-stage turbine, for a given steam flow or a given admission valve position, are a good indication of many internal conditions and frequently can be used as the signal for making unscheduled follow-up tests.

Fig. 3. Here is a typical log sheet for turbine vibration readings. On reverse side, you can enter data on conditions and work affecting vibration, so you will have complete story all in one place for future use

COMPANY (PRINT) — UNIT NO.____ DATES; FROM____ TO____

STATION ____ — VIBRATION IN 1/1000" BY (TYPE OF INSTRUMENT)____

LOCATION OF READINGS / DATES		BEST	LAST PREVIOUS														
GOVERNOR DOME	SIDE																
	END																
NO. 1 MAIN BEARING	SIDE																
	TOP																
	END																
SHAFT AT NO. 1	SIDE																
	TOP																
NO. 2 MAIN BEARING	SIDE																
SHAFT AT NO 4	SIDE																
	TOP																
SIGNED (EACH DATE)																	

Not all sudden changes in performance, however, are due to mechanical failures. A slug of carryover from boilers may plug blading sufficiently, under extreme conditions, to cause drastic changes in turbine performance.

Gradual changes in operating relationships are often due to an accumulation of scaly coatings on nozzle surfaces or actual clogging up of nozzles. This is more prevalent in stations generating steam at higher pressures and temperatures — the temperature playing the greater part by causing vaporization of troublesome solids and their condensation on turbine parts whenever and wherever they get back to the transition temperature. In some cases, partial relief has been obtained by one or another of the turbine washing techniques. The most effective method of avoiding this trouble seems to be to furnish the turbine with extremely clean steam.

Steam path details are designed for certain maximum safe pressure drops from point to point across rows of blades or diaphragms. There are tolerances provided for some contingencies, too; but, in the course of time, aging of parts and consequent growth of metal (particularly where operating conditions have become more severe) may have seriously reduced the original margins.

A pressure plot of all stages of both expected pressures and actual pressures, immediately after each general overhaul, when the unit is clean, becomes a valuable guide in analyzing turbine performance assisting materially in judging the need for internal inspection. (See Fig. 2, page 60, April 1952 issue.)

Semi-log ruling of graphs, with sufficient log cycles to cover the whole pressure range, has been found very helpful in analyzing turbine behavior and detecting irregularities.

Turbine Vibrations

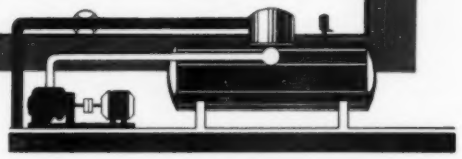
A vibration log should be kept on a weekly basis. The readings should

(Continued on page 88)

DON'T CLIP THIS ARTICLE

Others in your plant may want to read the complete issue, so if you want an extra copy of this or any other article, ask the Editor for tear sheets or a reprint. For convenience, use the postage-free card that you will find elsewhere in this issue.

Chemical De-Oiling of Your Boiler Feedwater



By **GEORGE S. EMMERSON**
College of Engineering, University of California

The problem resulting from the contamination of boiler feedwater by lubricating oil is different today from what it was when reciprocating engines were used as prime movers. In this article, author tells how to do chemical de-oiling, results to expect, and benefits

OLDEST AND MOST commonly practiced method of aiding the ordinary filter to remove the minute globules of emulsified oil from engine condensate is to introduce certain chemicals into the water. These chemicals react to precipitate particles (floc) bearing an electric charge opposite to that of the oil globules. The opposite electric charges have an attractive force. The particles of solid material, so introduced, collect around the oil globules to form larger and more filterable units, and/or neutralize the charge to enable the emulsified oil globules to coalesce and separate from the water as free oil. For this purpose, a suitable adsorbent with a cation of high valency is introduced into the emulsion. This is usually accomplished by adding chemicals which together react to produce a gelatinous precipitate or adsorbent of the required kind which acts in the manner just described. The process is called *chemical coagulation*, and the adsorbents or coagulants usually favored are the hydroxides of aluminum or iron.

Hydroxides as Coagulants

The gelatinous precipitate of aluminum hydroxide is normally obtained by adding aluminum sulphate in some form to the oily water along with an alkali — sodium carbonate (soda ash), sodium hydroxide (caustic soda), sodium aluminate, calcium carbonate or bicarbonate. Sometimes ammonium or potassium alum are used instead of aluminum sulphate because of their lower cost.

Commercial aluminum sulphate is most commonly used. In this form it is often called *filter alum* or *aluminaferric*, since it is an impure aluminum sulphate containing a little ferric sulphate. The salt, on the average, contains 53 per cent aluminum sulphate ($Al_2(SO_4)_3$), equivalent to 16 per cent alumina (Al_2O_3), the remainder being water. Uusally the aluminaferric is acidic and consequently has to be stored in vessels resistant to corrosion. However, it can also be supplied as a basic salt, though in this form it is not entirely soluble. In the formation of aluminaferric as a basic salt, a slight excess of alum shale, or bauxite, is used.

Aluminum and Sodium Reactions

Aluminum sulphate reacts with sodium carbonate in accordance with:

$$Al_2(SO_4)_3 + 3Na_2CO_3 = Al_2(CO_3)_2 + 3Na_2SO_4$$

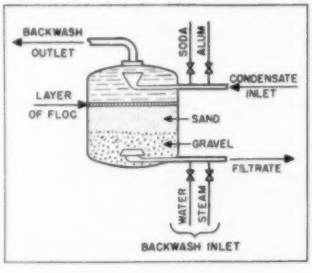
Aluminum Sulphate — Sodium Carbonate — Aluminum Carbonate — Sodium Sulphate

The aluminum carbonate thus formed, immediately breaks up into aluminum hydroxide and carbonic acid:

$$Al_2(CO_3)_3 + nH_2O = Al_2O_3nH_2O + 3CO_2$$

i.e., the complete reaction is illustrated by the chemical equation shown at the top of the next column:

Fig. 1. Cross-section of pressure-type sand filter



$$Al_2(SO_4)_3 + 3Na_2CO_3 + nH_2O = Al_2O_3(H_2O) + 3Na_2SO_4 + 3CO_2$$

The precipitate of aluminum hydroxide unites with the oil globules so that these now become easily removed by sedimentation and filtration.

In view of the corrosive properties of aluminum sulphate, it is important to ensure that all of it has been removed from the treated water. It has been suggested that it is better to ensure a slight soda alkalinity in the treated water. However, care must be taken when this condition exists as there is danger of aluminum hydroxide dissolving in excess sodium carbonate. In other words, the pH of the water must be controlled. It will also be noticed from the equation of the reaction that a quantity of free carbonic acid is liberated in the process. This is a disadvantage, since the quantity of carbonic acid liberated may be sufficient to have a definite corrosive action on the boilers and economizers.

Avoiding H_2CO_3

Caustic soda is often used in preference to sodium carbonate to avoid the production of carbonic acid. Then we have:

$$6NaOH + Al_2(SO_4)_3 = 2Al \cdot (OH)_3 + 3Na_2SO_4$$

Caustic Soda — Aluminum Sulphate — Aluminum Hydroxide — Sodium Sulphate

Too much caustic must not be used, as it too is soluble in excess and the alumina may be redissolved instead of being left free to coagulate the oil.

Neither aluminum sulphate nor sodium aluminate will precipitate their floc in pure distilled water, but the two together quickly neutralize each other to form sodium sulphate and liberate alumina. The result is a double coagulation which is very effective in removing the oil. Sodium aluminate is more useful than sodium carbonate in the oil removal plant since it carries both alkalinity and alumina. By using a slight excess of sodium aluminate in the treated

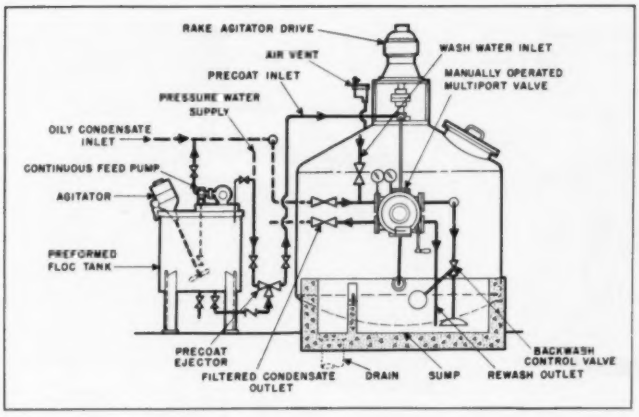


Fig. 2. Diagram showing arrangement of Permutit oily-water filter piping and the component parts

water, and a slight hydroxide alkalinity, very satisfactory results are obtained (See Beale & Stevens, JSCI, 1931).

Calcium carbonate or bicarbonate will precipitate the alumina from the sulphate but are open to the same objections as sodium carbonate in liberating free carbonic acid with, in addition, the production of calcium sulphate which forms a hard scale:

$$3Ca \cdot CO_3 + Al_2(SO_4)_3 = 3Ca \cdot SO_4 + Al_2O_3 + 3CO_2$$

If the raw water make-up contains hardness, a combined softener and oil eliminator is sometimes favored where the raw water does not exceed ten per cent of the feed. Considerations of size of softening plant required make it advisable to use separate plants where a larger amount of raw make-up water is used. Then the concentration of alkalinity usually required for coagulation is about 30 ppm and, of course, the higher the alkalinity of the raw water the less water required to be added to the condensate to achieve this. It has been considered inadvisable to use raw water make-up as a source of alkalinity unless it contains at least about 150 ppm. (Ref. [1])

The reaction which takes place is that described above, from which it will be noted that scale-forming calcium sulphate and carbonic acid are released. It is doubtful, therefore, if a combined softening and oil eliminating plant is justified on any grounds.

Where a continuous blow-down system is in operation, it has some times been found economical to utilize alkaline blow-down water to supply alkalinity for the coagulation process.

Sometimes used in preference to aluminum hydroxide, ferric hydroxide only differs in the reagents required for its production. Probably the best of all coagulating reagents, ferric sulphate reacts with an alkali to produce ferric hydroxide floc. As the following equations show, caustic soda is preferable to soda ash in view of the carbonic acid released by the latter.

$$Fe_2SO_4 + Na_2CO_3 + H_2O = Fe(OH)_2 + Na_2SO_4 + CO_2$$

or with caustic soda,

$$Fe_2SO_4 + 2NaOH = Fe(OH)_2 + Na_2SO_4$$

Ferric chloride is sometimes used instead of ferric sulphate, but forms soluble sodium chloride, and is not so satisfactory.

Within recent years an *activated* silica sol has been developed which has been used increasingly in the coagulation of domestic water supplies. Increases of more than 25 per cent over rated plant capacity has been attained with negligible increase in cost. Various patents have been taken out, and among other important uses for activated silica are the treatment of industrial waste, sewage and boiler water. It is a highly charged negative colloid and, used in conjunction with other coagulants, improves their effectiveness and pH range.

After coagulation, the oil globules are easily filtered from the condensate by means of the ordinary filter media (granular material is usually preferred) which otherwise would be unable to extract the emulsified oil. How would it do, then, to employ the chemical coagulant or floc as the filter media itself? Are the coagulating properties retained by a ready-formed layer of floc? Hatschek inves-

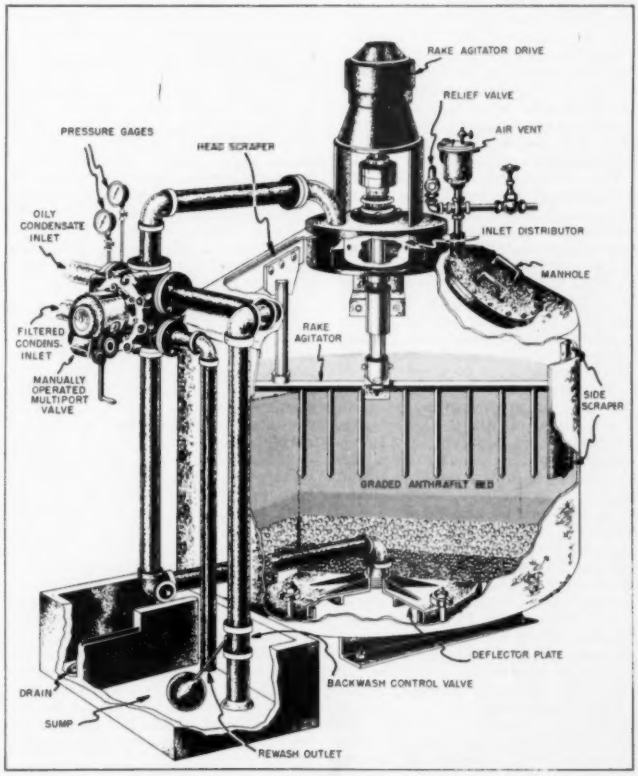


Fig. 3. Cutaway drawing of Permutit oily-water filter showing arrangement of filter bed elements

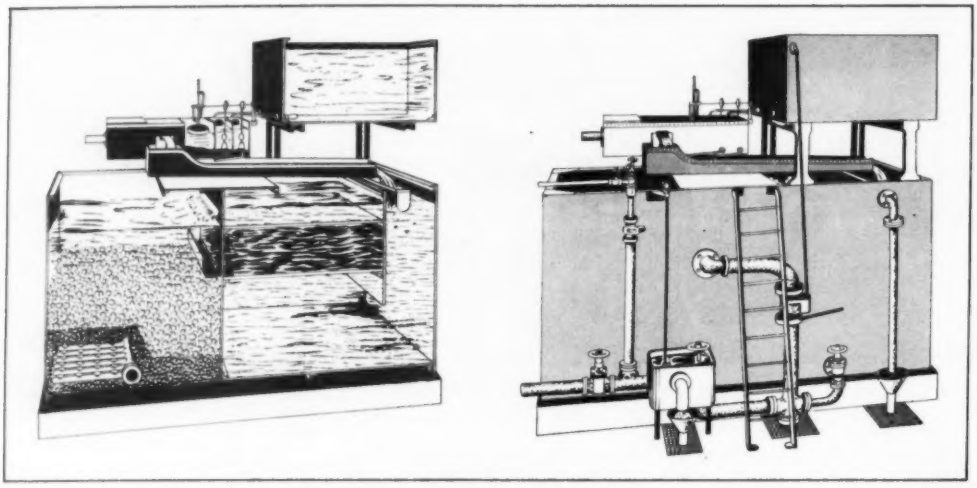


Fig. 4. Two views of the Paterson oil eliminator which is a type of gravity filter tank used extensively for de-oiling in Europe. Note arrangement of weir

tigated the question as long ago as 1910 (*Direct Separation of Emulsions by Filtration and Ultra-filtration*, JSCI, 1910) and found that although it was necessary to employ the hydroxide in the nascent state, as in the normal coagulation process, its effect, when used as a ready-formed layer, is exclusively due to its structure which provides innumerable and very minute baffles. Further, the filamentous or membranous structure of the hydroxide gradually collapses, or becomes consolidated, on standing. Thus it is necessary to produce it continuously.

The advantage of forming the hydroxide in the condensate is the fact that, during formation, the hydroxide is temporily in a colloidal state. Of course, the close mat formed by the coagulant on the surface of the filter acts as a temporary filter aid. Care must be taken to ensure that the reaction is properly completed, otherwise there may be corrosive chemicals (e.g. aluminum sulphate) carried over to the boiler. It is necessary, therefore, to regulate the pH of the water. According to Klein (*Purification of Dirty Condensates*, Waerme, v 56, Nov. 18, 1933), effective formation of aluminum hydroxide floc is only attainable within the pH range, 5.5 to 6.5 at a temperature between 68 and 86 F. Ferric hydroxide, on the other hand, has a very much wider range of effectiveness, particularly where ferric sulphate is used as a reagent. Stutson (*Power*, 1935), found that in conditions under which ferric hydroxide flox was effectively formed within a pH range of from 5.6 to 8.6, the production of aluminum hydroxide floc was only partially accomplished through a pH range of 6.7 to 6.8.An advantage, therefore, of adding the floc, pre-formed, to the water, is the avoidance of the need for pH control and, consequently, of the danger of carrying harmful chemicals to the boilers.

In one system that has seen increasing use recently, the floc is formed in a separate container and kept there in suspension as a slurry with a high speed agitator. This preformed floc is then injected into the filter as desired and excellent results are claimed.

Where the coagulating reagents are introduced separately to the contaminated water, it is important that they be quickly distributed. If this is not done, there is sometimes the danger of the floc being concentrated in a comparatively localized region. This allows the oil globules in the remaining volume of water to escape entanglement. To avoid this, the alkali should be added to the water after the acid.

Coagulating and Filter Plants

In the elimination of oil from condensate by means of chemical coagulation, the common pressure-type sand filter is extensively used. This comprises a body of sand supported as a flat horizontal bed by porous carborundum blocks, coarse gravel, or a fine metal screen. The thickness of this bed varies with the manufacture as also does the mode of support, and may be from 6 to 42 inches. The coagulant is added to the influent and forms a coating on the sand. After operation for some time, excessive back-pressure is developed by the filter and there is then danger of the floc layer cracking, so allowing more free oil to penetrate the bed. It is then necessary to by-pass the filter and clean it by back-washing with water or steam. It is becoming general practice now to use anthracite (anthrafilt) or quartz instead of sand, to avoid carrying over silica to the boiler.

A granular-bed pressure filter developed for removing oil from condensate, by the Permutit Co., is of great interest and is shown in Fig. 3. The notable features of this design are; the method for facilitating backwashing with a rake agitator, an operation that takes about ten minutes to complete and uses 4 to 5 gal per sq ft per min, and the use of floc pre-formed in a separate container. Scrapers are fitted to remove oil from the side of the filter and so prevent its creeping into the filtrate. The filtering rate ranges from 5 to 7 gal per sq ft per min. During operation, the pre-formed floc is fed continuously to the condensate by an adjustable stroke pump in proportion to the average oil concentration anticipated.

A gravity filter tank extensively used in Europe for de-oiling is the Paterson Oil Eliminator. The coagulating reagents are fed to the influent and the coagulation is completed in the reaction tank proper, which is of sufficient capacity to allow this to continue for 30 minutes. The flow is then directed upwards through a layer of wood fiber which removes the larger masses of coagulated and precipitated impurities. The water then passes down through a bed of graded anthracite, then to the discharge. Backwashing is by air and water. The device is made in standard sizes to deal with from 300 to 12,000 gal per hr. An oil eliminator to deal with 300 gal per hr measures, approximately, 5 ft by 2 ft 6 in by 7 ft 9 in over-all height.

Editor's Note: This is the third of four articles covering the problem of oil contamination. Electric de-oiling will be considered in a fourth article.

References

1 Schinman, POWER PLANT ENGINEERING, v. 36, n. 19. Nov. 1932.
2 Rohn, Trans. Soc. N.A. & M.E., v. 51, 1943.

Keep Stoker Dust Emission Down

You can do it by proper use of jets, turbulence, reinjection. Here's what they found in forty-seven tests made on a continuous-ash-discharge spreader-stoker-fired boiler furnace at Elyria

By
W. C. HOLTON
and
R. B. ENGDAHL
Battelle Memorial Institute

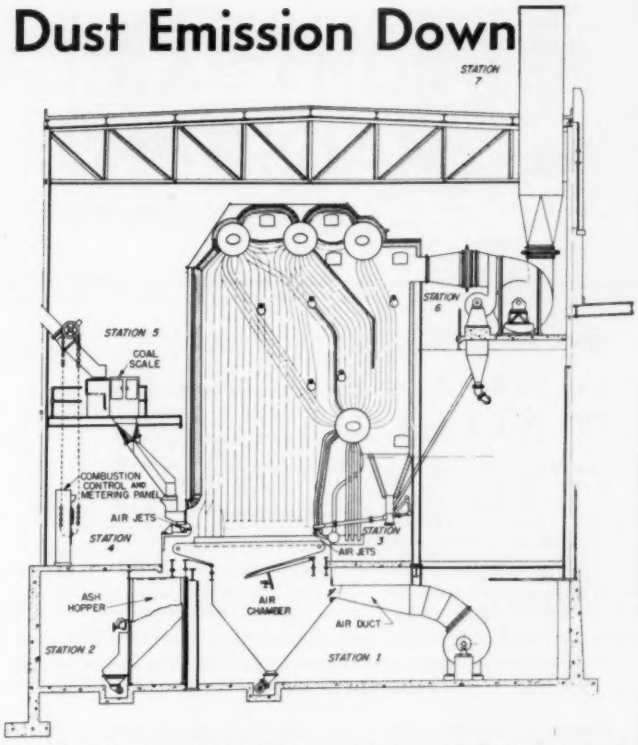


Fig. 1. Side elevation of boiler test plant showing location of various pieces of equipment used in tests

THE PUBLIC has become quite concerned with smoke and dust abatement programs during the past few years. Quite often they have brought pressure to bear on installations that are using suspension type burners such as the spreader stoker. As a result, the coal industry, with the co-sponsorship of a group of spreader-stoker manufacturers, initiated a research program at the Brown-Lipe-Chapin plant of General Motors at Elyria, Ohio, to obtain factual information on the amount of, and the methods of reducing, cinder and fly ash carry-over from spreader-stoker-fired boiler furnaces. Data were obtained simultaneously on smoke emission.

The Effects — of the following factors on dust emission were investigated to obtain these factors — overfire air and cinder reinjection, singly or combined; percentage of overfire air; steam jets; steam-air jets; location of jets; partial and total reinjection and coal size. A more detailed study of this subject can be found in ASME paper No. 51-SA-20.

The boiler shown in Fig. 1 is a 60,000 lb-per-hr four-drum bent tube unit. Three sides of the furnace are water-cooled. No superheater, air heater or economizer is provided. The unit is fired by a continuous-ash-discharge spreader stoker. Primary air is furnished by a forced-draft fan. Cooling air, which is admitted to the furnace under the stoker feeders, is taken off the primary-air duct. Overfire air is supplied to the furnace by a blower through three jets and two reinjection nozzles located in the rear wall. These jets are 18 in. above the grate in the rear wall and point down toward the imaginary intersection of the front wall with the grate. Five overfire jets are also located in the front wall, but are pointed in a horizontal plane.

A fly-ash-separating induced-draft fan provides a measure of dust collection as well as induced draft. The main purpose of the collector section of this fan is to protect the impeller rather than to reduce stack emission. A stub stack is mounted directly on the outlet of the induced-draft fan.

Instrumentation of the boiler and furnace consists of a steam flowmeter, draft gages, and combustion control.

Coal flows by gravity from live storage to an automatic coal scale and through a coal chute to the stoker hoppers.

Ash disposal is effected by a conveyor system which is piped to the collector hopper, grate-ash hopper and undergrate hopper.

The output of the boiler is normally used to supply process steam and heating load and to drive a large air compressor. Because much of the process steam is lost and, consequently, a large amount of make-up must be supplied, the plant uses a 240,000-lb-per-hr water-treatment system.

The Results — of these tests show that some significant conclusions were reached. The effect of overfire air with and without reinjection at various load conditions is shown in Fig. 2. These curves show the variation of smoke, CO_2, carbon loss in per cent of the heating value of the coal, and dust-loading at the furnace outlet as a function of burning rate for: 1) no overfire-air jets and no reinjection; 2) no overfire-air jets with reinjection; 3) overfire-air jets without reinjection; and 4) overfire-air jets with reinjection. It is evident from these curves that the use of overfire-air jets improves boiler performance by reducing smoke emission, decreasing carbon loss and reducing dust loading when operating above one-half load.

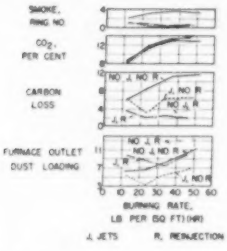


Fig. 2. Evaluation of comparative rates of fuel burning for tests with and without reinjection

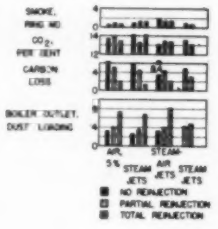


Fig. 4. An evaluation of the comparative degrees of reinjection used for all of the full-load tests

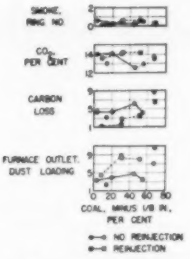


Fig. 6. The effect of the coal size on the results of full-load tests with and without reinjection

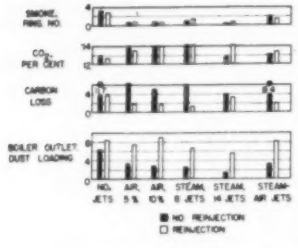


Fig. 3. Results from full-load tests with several types of overfire jets, with and without reinjection

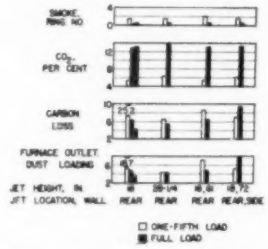


Fig. 5. Results from one-fifth and full-load tests without reinjection using several jet locations

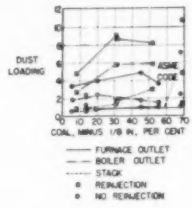


Fig. 7. Dust loading expressed as a function of coal size for tests with and without reinjection

NOTE:—In all the cases above, from Figs. 2 to 7, the dust loading is in pounds dust per 1000 pounds of gas and it has been adjusted to standard conditions

Effects of Various Jets — are shown in Fig. 3 where various types at one location with and without reinjection was tried. The graphs show the results of full-load tests run with one coal, both with and without total cinder return. The jets were arranged in various ways to provide turbulence. It is evident from the results that steam jets are more effective than air jets in reducing carbon loss and dust emission. However, the steam cost is from 5 to 7 times as much as the overfire air.

Effect of Reinjection — tests were conducted to obtain data on various degrees of reinjection. Figure 4 shows an evaluation of the test with no reinjection, partial reinjection (cinder return from boiler hoppers only), and total reinjection. From these results the conclusion can be made that if the absence of restrictive smoke ordinances or the use of a high-efficiency dust collector permits a plant to operate with total reinjection, valuable savings in fuel result.

The effects of using eight versus fourteen steam jets, all at the same elevation were compared. Increasing the number of steam jets improved the boiler performance.

Best Location of Jets — is shown in Fig. 5. The tests conducted so far proved that jets were necessary. These results show that low rear-wall jets are the most effective with regard to carbon loss and dust emission.

Effect of Coal Size — was determined with the boiler running full load and with nine steam jets in the rear wall and five steam jets in the front wall, all 18 in. from the grate. Figure 6 shows the results in smoke density, CO_2, carbon loss, and dust loading as a function of coal size with and without reinjection. The most important over-all conclusion which may be drawn is that the use of coal containing a small percentage of minus ⅛-in. material contributes a low carbon loss and low dust loadings at the furnace outlet. This trend is most marked when operating with total reinjection.

Dust Loading — is shown in Fig. 7 at the furnace outlet, boiler outlet, and stack as a function of coal size for tests with and without reinjection, all tests being run at full load. Note that the curves for emission at the furnace outlet are quite steep, whereas the slope decreases for the boiler outlet. At the stack, the results for the tests without reinjection plot nearly on a straight line.

Summary — of the most significant results of these tests is as follows:

1 — Jet turbulence, whether provided by steam or by air, is needed to assure low smoke densities required by municipal ordinances. The use of overfire jets also reduces the carbon loss and dust emission from the furnace. The lowest dust emission was obtained when 14 steam jets (nine jets low in the rear wall, plus five jets in the front wall) were used. This condition also gave the lowest carbon losses for the tests without reinjection, but the test with eight steam jets (three jets low in the rear wall plus five jets in the front wall) showed the lowest carbon loss for the tests with total cinder reinjection.

2 — Reinjection of cinder from the boiler hoppers decreased carbon loss 2.3 to 4.1 percentage points, while increasing dust loading from 20 to 40 per cent. Returning all the collected cinder (from both boiler and collector hoppers) to the furnace gave a further decrease in carbon loss of 2.1 to 2.8 percentage points at the expense of an increase in dust loading of 125 to 155 per cent.

3 — The use of coal containing a small percentage of minus ⅛ in. material resulted in lower values of carbon loss and dust loading at the furnace outlet than were found with finer coal. This decrease was not so great at either the boiler outlet or the stack. In no case was the dust loading at the boiler outlet reduced enough by burning double-screened coal to enable the plant to meet the proposed smoke ordinances without the use of a collector. Coal size had a negligible effect on smoke density.

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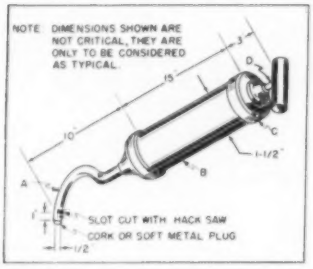


Fig. 1. Ordinary grease gun can be speedily modified to make a low-cost sampling device

When, Where and How To Sample Fuel Oil

By J. P. STANTON*
American Commercial Testing Corp.

FUEL OIL consumers generally sample oil for one or more of the following reasons: *trouble shooting*, to determine what part, if any, of operating difficulty is due to the oil; *quality control*, to make certain the supplier is furnishing oil which meets specification; *preventive maintenance*, to check condition of storage tanks, performance of additives, etc.; and *court actions*, to obtain fuel oil analyses having legal status.

Listed in probable order of their importance in the light of present day industrial practice, sampling of fuel oil in programs of preventive maintenance, though listed third, eventually may become the most important one of all.

Trouble Shooting

When industrial oil burners develop operating troubles, it is invariably good practice to take an oil sample at once and check for quality. This is a wise habit to acquire, even though most suppliers act in good faith and have satisfactory control over their product's quality.

In the first place, it is reassuring to the power engineer to know oil is in no way responsible for his troubles. In addition, certain very trying and costly situations may be avoided. For example, consider a case in which a supplier, consistently delivering high quality oil, allows an off-standard load to slip through. Poor combustion conditions result, and the plant's power engineering staff goes to work — perhaps to the extent of calling in oil burner service specialists or consulting combustion engineers for assistance. They find, let us say, that improper preheating temperature and fuel-to-air ratios exist. Readjustments are made, and combustion conditions improve. However, with subsequent fuel deliveries the oil regains its original characteristics. End result? Return of poor combustion conditions. Further work then is required to make needed readjustments.

When trouble develops, and fuel sampling is a standard checkpoint, the most desirable sample is one which is representative of oil being fed to burners at that time. For this reason, the sample should be taken from a point in the feed line as close to the burner as possible. In very large and modern installations sampling connections are usually provided. In smaller installations, where this is not always the case, it is most convenient to sample directly from the strainer bowl.

To take samples from the strainer bowl it is necessary to shut down the burner, unless dual strainers have been provided to facilitate cleaning. If the strainer is large, a passable sample can be obtained easily by carefully dipping the fuel out of the strainer basket with a small, clean can. Even better, the use of a modified grease gun, shown in Fig. 1, is recommended as a low-cost, highly suitable sampling device. Guns of this type are sold everywhere by large retailers, such as Sears Roebuck & Co., at $1.50 to $2.00 each. Modification is simple and furthermore, the guns are easy to take apart and clean after sampling.

Procedure involved in sampling from strainer bowls with this modified gun can be summarized as follows:

1. Shut down the burner, unless dual strainers are provided.

2. Remove the top from the strainer bowl. *Do not remove* the strainer basket itself, for in so doing the sample will be filtered before it is collected, thus spoiling it.

3. Lightly resting the plugged end, shown in Fig. 1 as A, of the sampling gun on the bottom of the cup-shaped filter screen, slowly suck fuel oil into the gun. Care should be taken not to disturb sludge or sediment clinging to the inside of the filter basket.

4. Transfer at least 1 pt of the oil to a clean, dry container. A pint is sufficient for a full set of ASTM-U.S. Department of Commerce specification tests on all fuel oils except grades 1 & 2. A quart sample is preferred for these two lighter grades.

5. Replace the strainer bowl cover and start the burner again.

6. If the bowl capacity is insufficient to permit the taking of an entire pint or quart sample, repeat the above process.

7. Label the sample and include date, description of sampling point and reputed grade of oil.

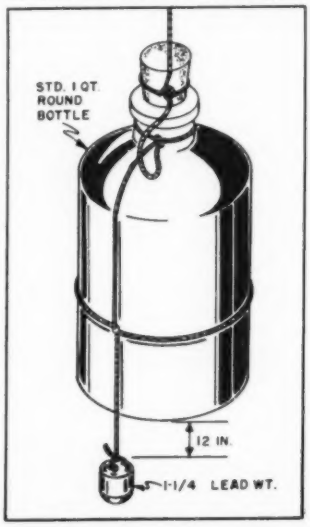
8. Unscrew cap, C, of gun, remove plunger, D, and wash all parts with a solvent such as kerosene. Dry parts with clean cloth and reassemble the gun for use in the next sampling job.

Quality Control

To accurately judge if the supplier's product is in conformity with specifications, such factors as dirty storage tanks, formation of sludge and addition of fuel oil "treatments" must be eliminated during sampling. This can be done simply by catching the sample directly from the delivery vehicle or vessel.

Simple method of securing a pass-

Fig. 2. Weighted quart bottle makes a satisfactory substitute for an expensive sampling thief



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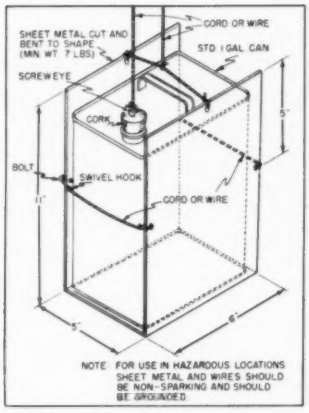


Fig. 3. One-gallon samples can be taken directly into container with homemade contrivance

able sample from smaller delivery vehicles, such as tank trucks, is to stop the unloading process near the midpoint and fill a sample container directly from the hose. A more reliable sample can be taken from the middle of tank cars and barges with a "thiefing" apparatus.

"Sampling thiefs" can be purchased from laboratory supply houses. They are relatively expensive and most have the disadvantage that the sample must be transferred to another container for shipment. A clean, dry bottle or small can may be easily converted into a satisfactory substitute for taking samples as large as 1 qt, as shown in Fig. 2.

To check the quality of diesel fuel oil, it is usually necessary to determine the cetane number in addition to standard tests. In this case, 1 gal of sample should be taken. An easily-fabricated thief, shown in Fig. 3, permits the taking of samples directly into a 1-gal can. A large transit company which conducts a routine quality control program on each of its three fuels (diesel fuel oil, gasoline and propane) uses this type of thief. It is so compact that it can be lowered through the hatches of all types of oil tanks.

In thiefing a sample from beneath the surface of the oil or fuel, the following procedure is suggested:

1. Obtain a clean, dry container of suitable size.

2. Stopper the container and place it in the thiefing unit, or attach weights as shown in Fig. 2.

3. Attach a light chain or heavy cord to the container and a second cord to the stopper.

4. With one hand, lower the unit to the bottom of the delivery tank, allowing the two cords to slide through the other hand.

5. Observe the depth at which the container touches bottom, then withdraw it.

6. Grasp the container supporting the cord at a point such that the container can be lowered just halfway to the tank bottom.

7. Lower the weighted container to the halfway mark, pull out the stopper with the second cord, and allow it to fill.

8. Remove the full container and pour off about 15 per cent of the fuel to allow for expansion.

9. Seal the can and fill out label including date, sampling point, and reputed grade of oil. Avoid using soft pencils or pens when making out the label to forestall possible smearing from rubbing or moisture.

Preventive Maintenance

In preventive maintenance programs it is important to remember such factors as condition of storage tanks, sludge formation in oil, accumulation of corrosive water, need for additive application, and the effectiveness of additive treatments.

In general, it is entirely satisfactory to use the same sampling point and procedure as in trouble-shooting operations. The important factor here is timing. It is strongly recommended that samples be taken *not less than 8 hr and not more than 32 hr* after a delivery of oil has been unloaded into the storage tank from which the oil burner is taking suction. During this period riling of tank contents is probably greatest; therefore, the sample is of the poorest oil being fed at any time to the burners. One exception: where there is a possibility of considerable sludge because of prolonged storage.

Two conditions must be fulfilled, relative to sampling, in order to obtain a legally acceptable fuel oil analysis. First, an unbiased party must do the sampling — unless, of course, the two parties involved reach some mutual agreement. Second, if applicable sampling regulations exist, sampling procedure must follow those regulations.

Most "referee" sampling work involved in lawsuits is performed by reputable commercial laboratories, legally recognized as unbiased authorities. In instances where established standard sampling procedures are nonexistent, the laboratories' sampling methods, based on experience, generally are admissible. For "referee" fuel oil sampling techniques, refer to ASTM D270-50T, Sampling Petroleum and Petroleum Products, in the *1950 Supplement of ASTM Standards.*

It is well to keep in mind that the analysis can be no better than the sample, whatever the purpose. An applicable paragraph from the April 22, 1948 *Oil and Gas Journal* states, "One would think that sampling is such a routine and simple matter that little attention is required, but the erroneous conclusions that can be drawn from a nonrepresentative sample are so confusing and sometime so expensive that all of the skill of a conscientious man is required."

Cooling San Patricio's 83 Gas Engines

ENGINE-COOLING task at Reynolds Metals Company's new San Patricio aluminum reduction plant near Corpus Christi, Tex., is a gigantic one. Eighty-three gas engines, developing 287,000 hp, generate 543,000,000 Btu per hr which must be dissipated.

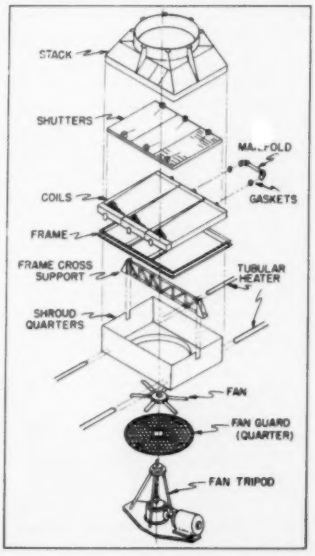
All cooling units used are designed to operate at 100 psig, and all coils are tested at 200 psig. Both copper and aluminum coolant-carrying tubes are used. Fin plates or secondary surface is aluminum throughout. The plenum chambers and stacks are of heavy reinforced steel designed to withstand 125-mph winds. Water and oil tanks are of fabricated steel.

Each of 42 Cooper-Bessemer engines (3700 hp) has 2 one-pass water-cooling coils, with horizontal cores, rolled into a steel tank. Water coil manifolds connect the coils in series. Each engine has 1 single-pass oil cooling coil with turbulating-type agitators, easily removed, inside tubes.

Each of 41 Cleveland Diesel Division engines (3200 hp) has 4 vertically-mounted water cooling coils and 2 vertically-mounted oil cooling coils. Water coils are single-pass, have aluminum cores, and are connected in series.

All cooling equipment is supplied by the Young Radiator Corp.

Diagram showing construction details of cooling unit used with each of forty-two 3700-hp engines



Maker and User Can Anticipate Maintenance Problems

By **F. L. BRADLEY,**

Forstmann Woolen Co., Passaic, N. J.

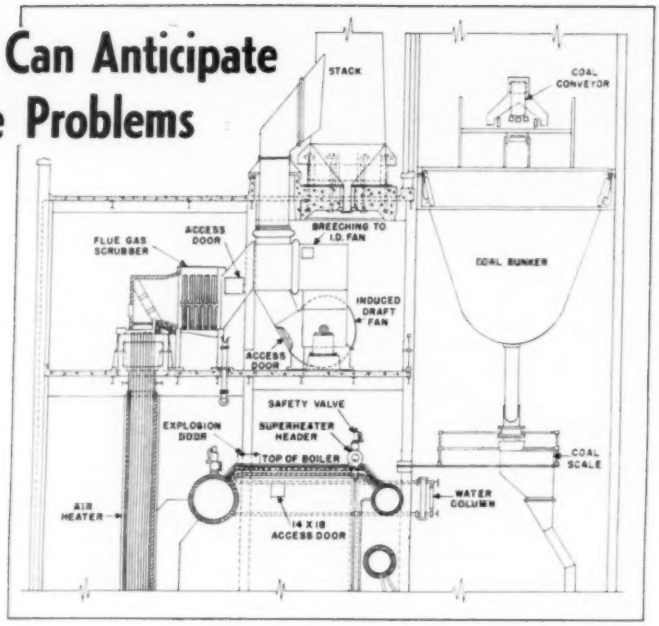


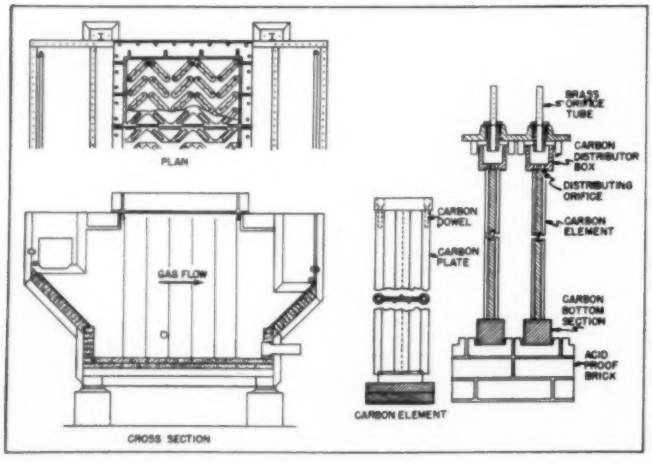
Fig. 1. Cross-section of flue gas scrubber showing arrangement of vertically suspended baffle plates

Whenever a new piece of equipment is put on the market there are bound to be some *bugs* in it. Here is how they got 'em out of a new flue gas scrubber

CLOSE CO-OPERATION between the manufacturer and the user of a piece of equipment is a boon to both parties. The user can suggest changes and improvements to the manufacturer so that a product will do a better job and often at lower cost.

The flue gas scrubber shown in Fig. 1 is a good illustration of possibilities for co-operation between manufacturer and operator in meeting anticipated maintenance problems. This unit was the first commercial installation by the manufacturer and therefore the possibility of maintenance problems were anticipated. With this in view, certain maintenance provisions were included in the original purchase contract.

Fig. 2. Plan and elevation drawing showing flue gas scrubber construction and arrangement details



How This Scrubber Works

This flue gas scrubber is based on the principle of trapping dust particles in a film of water which runs over a series of baffle plates suspended vertically in the gas stream. It is essentially a box installed in a horizontal flue and provided with openings on the front and rear to permit passages of gases through it. A shallow water tank closes the top of the scrubber and serves to support the baffles. The bottom of the scrubber is a rectangular basin that collects the water and entrained dust prior to their discharge to waste. The entire unit is erected on a structural-steel support.

Operation and Control

The operation of the unit is simple and requires little attention. The water level in the supply tank is controlled by a float-operated valve. Water is admitted to the scrubber chamber and distributed to the entire surface of each baffle by orifices located in the bottom of the water tank. The baffles are of ribbed construction to permit the spread of

water over the entire surface. The flue gases entering the unit pass over five sets of baffles, so arranged as to permit ample contact of the gas with the wetted baffle surface. The wetted dust and water are collected in the bottom and discharged to waste through water-sealed discharge nozzles.

What It Is Made of

The scrubber is made of materials designed to resist the corrosive action of acids and the erosive action of the fly ash. The first set of baffles were made of cast iron coated with an acid resisting enamel. Several other metals, including Everdur and special alloys called Ni-Resist and Riloy, were tested. The cast iron housing was lined with chemical tile set in acid-resisting cement. The water tank and basin were also made of cast iron painted with acid-resisting paint.

How It Stood Up

The baffles were the most vulnerable parts of the scrubber. They were subject to the erosive effect of the fly ash as well as the corrosive effects of the acid solutions formed in the scrubber. The initial cast-iron baffles painted with special acid-resisting baked enamel lasted, on an average, approximately 1000 boiler operating hours. During this time, 1180 tons of coal containing 7.5 per cent of ash and 1.75 per cent of sulphur were burned. The cast-iron baffles were replaced with nickel-cast-iron alloy baffles.

These plates were inspected after approximately 4000 hours of operation. During this time, approximately 1650 tons of coal containing 7.5 per cent of ash and 1.75 per cent of sulphur were burned. While these plates showed wear, the effects were not alarming.

The manufacturer used ceramic baffles in installations at other plants with better but not complete success. Carbon baffles similar to those shown in Fig. 2 were installed in 1936. This material has been completely successful in withstanding the effects of acid corrosion and fly ash erosion. Based on satisfactory performance of the carbon baffles as well as other potentially vulnerable parts of the scrubbers, it was agreed that the manufacturer had fulfilled his part of the contract and the maintenance provisions were terminated.

Steam Turbine Lubrication

Summarized here are definite trends in design and maintenance of turbine oil systems, in oil specification and testing and use of inhibitors

THE PAST 10 to 15 years have been notable in turbine lubrication history. Both the oil and the oil system have undergone radical changes. The outstanding feature has been the interchange of ideas and practices between the producer and consumer.

During this time, the Power Station Chemistry Subcommittee of the Prime Movers Committee, Edison Electric Institute, has been continuously active in the study of turbine lubrication. The many experiences and problems revealed at the subcommittee meetings indicated the widespread diversity in the practices of the member companies. Consequently, three questionnaires were circulated covering general phases of the problem, such as, oil and system design, maintenance and lubrication systems, and oxidation-inhibited oils.

The questionnaire summaries not only indicated past experiences but, in a number of instances, revealed definite trends in both the thinking and the practices of company personnel with respect to: a) the design, preparation, and maintenance of the system; b) the use of specifications and the testing of new oil; c) the treatment, maintenance and testing of oil in service; and d) the use of oxidation- and corrosion-inhibitors. Summaries of each phase of subject are presented below.

Turbine Oil System Design

Oil-system designs varied from stations with a common sump or reservoir for all the units, to a few with separate systems for governor and bearing oil. Most reports showed an individual system for each unit. The bearing and governor oil was supplied from one reservoir and there was little or no intermixing of oil or the separate units. This appears to be the trend in present construction, also.

When the generator is hydrogen-cooled, the seal-bearing oil is circulated in a system almost independent of the main circulating oil. It is connected so that at no time will the oil in the hydrogen-cooled system fall below the required level. The hydrogen-cooling system is normally provided with a means for degasifying the oil and keeping it dry.

Preparation for Service — The Power Station Chemistry Subcommittee cooperated with Section 1 of Technical Committee C, ASTM Committee D-2, in writing a detailed procedure (*Proceedings*, American Society of Testing Materials, Vol. 47, p 289, 1947) for preparing new turbine systems for service. Frank C. Linn, Turbine Divisions, General Electric Co., who was a member of this ASTM Committee and who helped prepare the procedures, wrote a series of articles on oil systems for industrial turbines. This series of articles ran in April, May, June and August, 1949 POWER ENGINEERING.

Both the Proceedings and Mr. Linn's articles emphasize extreme care is necessary in cleaning a new system to ensure removal of debris and contaminants resulting from fabrication and erection of units.

In 1945, 16 companies reported, in answer to the questionnaire, distributed by the Power Station Chemistry Subcommittee, they had established a cleaning procedure for new units. Three additional companies stated they followed the recommendations of the manufacturer. Eighteen companies reported the use of a preliminary flushing oil, of which five employed old oil, nine new turbine oil, three a special light oil (sold by the refiner specifically for system-flushing), and one, cleaning naptha. The oil for flushing was circulated at temperatures varying from room temperature to 160 F for periods ranging from eight hr to two weeks. Foreign material was removed from the flushing oil by one, or a combination, of the following: centrifuge, blotter press and filter bag. Drainage of the flushing oil was followed by visual inspection and cleaning of accessible system parts.

Painting — Painting of the oil system as protection against corrosion was reported by 17 companies. Rustban 297 was tried by 10. Seven reported results which were not completely satisfactory. However, where this coating was used, no severe rusting occurred. Some repainting was done, but no complete repaint job was necessary.

Operating Temperatures — The majority of units operate with bearing-discharge temperatures in the range of 120 to 140 F. Occasionally a unit has a bearing-discharge temperature as low as 100 F or as high as 170 F. In most cases the temperature increase between inlet and outlet of a bearing is 20 to 35 F. Any study of oil service life must include the temperature effect, because exhaustion of the oxidation-inhibitor and oxidation of the oil are accelerated with temperature increase.

Venting — Venting to remove moisture from oil systems and to prevent corrosion above the oil level has proved beneficial. The majority of the units operating today vent to some degree. Most of the newer units have mechanical exhausters installed. Many of the old units are vented by opening some part of the oil system

to the atmosphere in suitable manner.

When an exhauster is used, it is usually placed on the main reservoir and a partial vacuum of from one to five in. of water is maintained on the reservoir. A higher vacuum may cause excessive foaming and possible infiltration of foreign material at the oil seals. On the old systems, venting is done by opening some part to the atmosphere where water vapor is known to collect and condense on the metal surface. The cover plate on the strainer box or inspection plate on the main reservoir is frequently tilted to produce the desired effect.

Turbine Oil

Purchase Specifications — Purchasing oil on specification was reported by 8 of 26 companies reporting. However, they alter their specifications to obtain oil having improved oxidation- and rust-preventing characteristics. Corrosion-inhibitors, particularly, have tended to cause higher steam emulsion numbers and neutralization numbers than those normally accepted for new oil. The remaining 18 companies purchased by brand or specified oxidation-inhibited oil, either with or without corrosion-inhibitors. Twenty of the companies specify inhibited oil for new units, and 14 use it in old units. It is probable a higher percentage of companies use inhibited oils since, in 1948, 19 of the 22 replying were using or were about to use that type.

Make-up Oil — Make-up oil is, in most cases, new oil of the same quality as the initial oil placed in a unit. In oil systems of which the make-up can be accurately measured, the requirements generally run between 7 and 12 per cent of the volume of oil in the system per year. Occasionally a lower or higher percentage is reported. These percentages are not accurate figures that can be used for comparison. There is no uniform ratio between kilowatt capacity of a unit and volume of oil in the system. No appreciable difference in the make-up requirement of a unit with either type of oil is noted when the unit was in continuous service. Where a difference could be detected, it could usually be attributed to the oil required to replace that lost during outages for the removal of sludge precipitated from uninhibited oil.

Oil Tests — In 1945, a total of 21 different tests were made on new oils and 19 on oils in service. No one laboratory made all the tests, nor was any one test made by all. In 1948, a total of 21 tests again were made, the neutralization number on used oils being the only test made by all laboratories.

The five most popular tests are: neutralization number, viscosity, steam emulsion number, interfacial tension and gravity. Of all these tests, the interfacial tension test has shown the greatest increase in popularity. Also it is the only test in which most laboratories agree on procedure that will give accurate results.

Critical Test Values — In 1945, in answer to a question on test limits at which an oil should be discarded, six of the 28 replies gave as an answer, a sudden increase in neutralization number, five gave a limit of 0.80 in the same test, and four gave per cent by weight of sludge. Two based rejection on interfacial tension, while the remaining replies gave various limits on neutralization number and steam emulsion number.

Of necessity, these criteria for rejecting a serviced oil have been based on experiences encountered with older, noninhibited oils. Few companies have had new oil in service a sufficient time to encounter failures. Should these new oils fail, they would not follow the pattern set by older oils in showing a slow but steady increase in neutralization number. A study is being made to determine if the interfacial tension test may be of more value in disclosing incipient sludging tendencies than is the neutralization number.

Maintenance — Maintenance of oil in service was accomplished by both centrifuge and filter systems in 1945, seven companies using the former and six the latter. The remaining companies did not report. In 1946, of the 26 companies reporting, 19 used the centrifuge, 9 used the blotter press, 5 used Alsop filters, and 4 used Honan-Crane. Following this report, in 1948 when the replies were made by unit, 22 were equipped with filters, 12 with centrifuges, and 7 with both. In this last year, 23 companies stated that they used purification methods to clarify and to remove sludge, 18 to remove water, 8 to reduce the steam emulsion number, and 6 to reduce the neutralization number.

Inhibited Oils — Since 1936, a year which saw the advent of inhibited oils, the past practices of utilities in turbine-oil handling have undergone rather radical changes. The practice of *batching* or *resting* is fast disappearing. This method requires an extra batch of oil for each unit or small number of units. While one batch is being used, the other is placed in a rest tank until it is used.

Another practice, no longer in widespread use is *sweetening*. Periodically a portion of the oil was withdrawn and discarded and replaced with new oil.

In 1946, several companies reported failures of inhibited oils in which sudden and severe sludging occurred. When the oil refiners were checked, no satisfactory answers were received. At that time inhibitors were a closely guarded trade secret.

In connection with inhibited oils, the statement made in 1949 by a member company is of interest:

> "It is possible to maintain clean oil after 100,000 hours in a turbine system that is in service 95 per cent of the time. This system has 10 per cent make-up per year and requires cleaning of the oil coolers on the oil side once every three years, then only to remove a light film of sludge. The bags in the Bowser filters are replaced at five-year intervals. An uninhibited oil had 10,000 to 15,000-hr service in this unit when sludge formation and high neutralization number necessitated replacement of the oil. The oil coolers had to be cleaned at six-month intervals and the filter bags replaced yearly.

Highland Cotton Mill Saves 25% With New Substations

SAVINGS of approximately 25 per cent on motor maintenance and 20 per cent on light bulb replacement have been effected at the Highland Cotton Mill, High Point, N. C., since the installation of five new General Electric load center substations.

Before the new larger power units were installed, the company had three 750 kva transformers which had progressively become more and more overloaded owing to increases in the mill electrical load. This overload and relatively long cable runs to many of the motors resulted in unduly low voltage at motors, causing them to overheat. Attempts to maintain motor voltage by using higher voltage taps on the transformers caused high voltage during light load periods and resulted in excessive lamp burn-outs.

To correct the situation and to provide additional power for anticipated further increases in mill load, four 1,500-kva and one 750-kva load-center unit substations were installed. The various units were strategically located to obtain minimum length of cable to the load each unit served. The result has been stable voltage and maintenance savings.

The North Carolina company manufactures hosiery and underwear yarns, producing approximately 110,000 lb per week. It now has sufficient power capacity to increase production by 25,000 to 50,000 lb weekly.

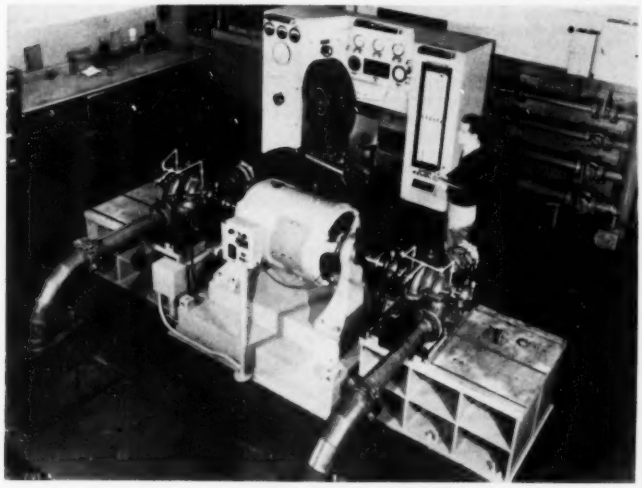
New Centrifugal Pump Test Stands Lower Testing Cost

By **PAUL NURKO**
De Laval Steam Turbine Co.

NEWLY-DESIGNED centrifugal pump testing stations have reduced overall test costs 75 per cent during a 12 month trial period by the De Laval Steam Turbine Co.

Engineered to give complete reproduction of performance for pumps of all sizes and ratings, the installations are designed primarily for production testing but have proved valuable in research and development. The permanent installations offer an accurate means of obtaining trouble-free, proven pumps to fit given system heads.

Fig. 1. New test stands consist of double-ended dynamometer between two prealigned pump bedplates



Test stands, Fig. 1, consist of a double-ended, electric dynamometer mounted on a hydraulic lift (powered by an electric motor) between two prealigned pump bedplates. Pumps of one rotation are coupled to one end of the dynamometer shaft by means of sliding type couplings — pumps of opposite rotation to the other end. Special clamping and alignment fixtures on doweled pads reduce aligning time to minutes. A one ton electric crane simplifies pump handling.

Piping simulating actual field installation has interconnected water reservoirs totaling 400,000 gal. The system head is low and additional friction created by a motor operated valve allows pumps to be tested over a wide range of heads.

Test Procedure

Tests are conducted from a control desk and panel containing highly sensitive instruments. Instruments used include permanent venturi manometers, pressure gages, field rheostats, a synchronous electric tachometer, and a stroboscopic light. A gage tester in the panel gives calibrations in a matter of seconds.

Before the start of a pump test, the test engineer carefully reads an engineering order card giving complete hydraulic and motor data. Operating conditions are then simulated at the control desk and the pump is operated at the rated speed of its motor. Data is recorded for a minimum of 6 test points. Readings of pressure, flow and power input are taken only after conditions are stable. The standard test follows all procedures of the latest hydraulic codes.

Thirteenth Annual Water Conference

THE Engineer's Society of Western Pennsylvania is sponsoring the Thirteenth Annual Water Conference, October 20, 21, 22, 1952, in the Hotel William Penn, Pittsburgh, Pa. Any information other than that listed below can be obtained by writing the Society Office, Hotel William Penn, Pittsburgh 30, Pa.

The program will consist of the following sessions and papers:

Monday Morning, October 20th

Registration.

Experiences with Chloride Anion Exchangers for Reducing Alkalinity With Acid by S. B. Applebaum, Manager, Water Treatment Division, Cochrane Corporation, Philadelphia, Pa.

* * *

Monday Afternoon, October 20th

Problems of Applying Deaerating Heaters to Unusual Specific Industrial and Utility Feedwater Cycles and Operating Conditions by V. J. Calise, Graver Water Conditioning Company, N.Y.C., N.Y.

Deionization, Its Practical Aspects for Boiler Feed in Hard Water Areas by T. C. Hoppe, Black & Veatch, Kansas City, Mo.

* * *

Tuesday Morning, October 21st

Advances in Process and Cooling Water Treatment by A. E. Griffin, Wallace & Tiernan Company, Newark, N. J.

Application of Metallic Phosphates to Cooling Water Treatment by H. A. Malley, Deady Chemical Company, Kansas City, Mo.

* * *

Tuesday Afternoon, October 21st

Symposium on Cooling Towers. Papers will be presented on

The Effect of Circulating Water on Wood in Cooling Towers by J. S. Hill of Esso Standard Oil Company, Baton Rouge, La.

Bacteria Growths and Their Control by R. S. Wise, National Aluminate Corporation, Chicago, Ill.

Depositions and Their Control in Cooling Tower Waters by George Illig, Hall Laboratories, Pittsburgh, Pa.

Corrosion and Its Control by J. F. Wilkes, Dearborn Chemical Company, Chicago, Ill.

A Review of Testing Techniques in Cooling Tower Waters by J. K. Rice, Cyrus Wm. Rice Company, Pittsburgh, Pa.

* * *

Wednesday Morning, October 22nd

Effect of Operating Pressure on Carbon Dioxide Content of Steam by J. J. Maguire and R. E. Winston, W. H. & L. D. Betz Company, Philadelphia, Pa.

Control of Resinous Materials in Low Pressure Boiler Feedwaters by W. L. Andrews, Bird Archer Company, Coburg, Ontario.

* * *

Wednesday Afternoon, October 22nd

Removal of Oil from Condensate by Diatomite Filtration by G. R. Bell, Johns-Manville Corp., Manville, N. J.

Will Your Blow-off Valves Stand the Acid Wash?

By W. G. STEINMILLER and H. G. EBERT

Engineers, Yarnall-Waring Co.

ACID WASHING of boilers and other power plant equipment long has been recognized by power engineers as an effective means of preventing or at least shortening costly down time. Use of a 5 per cent solution of inhibited hydrochloric acid at 150 F has, in fact, become a more or less standard cleaning reagent, especially in combating boiler scale.

Scale, of course, retards heat transfer and causes loss in boiler efficiency; and, what is more important, many times is responsible for overheating of boiler metal often resulting in tube failure. See Fig. 1.

Hydrochloric acid, even though inhibited, removes an appreciable amount of the metal surfaces it contacts. There is no acceleration in boiler *tube* deterioration from using acid because the amount of metal removed is comparable to that removed by mechanical means. This is not true, unfortunately, of blow-off valves.

Blow-off valves are not affected by mechanical cleaning but in acid cleaning, acids are pumped into the boiler through blow-off valves at relatively high velocities to reduce the time element. This flow rate increases corrosive action upon the valves during the filling period. Discharge of the acid again subjects the valves to intensified corrosive action.

Many valve trim materials in use are prone to attack by boiler cleaning acids and are, therefore, not suited for such installations. The Yarnall-Waring Company's Research Department has made extensive tests on various trim materials under conditions closely simulating acid cleaning to determine types of material best fitted for this service. Test equipment used is shown in Fig. 2.

Fig. 1. Section A shows normal temperature drop; B depicts temperature drop caused by formation of scale. Since boiler water temperature is fixed, Section C shows actual temperature condition of metal

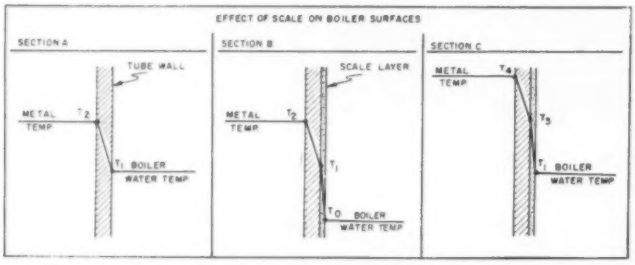


Table of the corrosion factors of some of the trim materials included in the simulated acid-washing test

Alloy	Resistance to 5 per cent Inhibited Hydrochloric Acid at 150 F		Acceleration of Attack on SAE-1020 Steel in Contact with the Alloy
	Individually	Contacting Steel	
Hastelloy "B" (Rolled)	Excellent	Excellent	1.0
Hastelloy "D" (Cast)	Excellent	Excellent	3.0
316 Stainless Steel	Good	Excellent	1.4
Stellite No. 6	Good	Excellent	Pitting around stellite
317 Stainless Steel	Good	Excellent	1.8
310 Stainless Steel	Good	Excellent	1.4
Hastelloy "B" (Cast)	Good	Excellent	2.4
Ni-Resist No. 4	Good	Good	2.4
Ni-Resist No. 1	Fair	——	——
303 Stainless Steel	Fair	Fair	1.5
420 Stainless Steel	Fair	——	——
"S" Monel	Fair	——	——
"K" Monel	Poor	Excellent	2.8
316 Stainless Steel (Nitrided)	Poor	——	——
SAE-1020 Steel	Poor	——	——
Beryllium Copper	Poor	Excellent	4.1
SAE-8630 Steel	Poor	——	——
416 Stainless Steel	Poor	——	——

Fig. 2. Test apparatus consisted of open pyrex vessel containing acid solution covered with an oil film to prevent aeration and evaporation, a slow-speed motor-driven stirring rod, and a large glass tube providing an oil-free entry for specimens

Corrosion of Materials

Some of the alloys tested and their relative corrosion resistance individually and in contact with SAE-1020 steel are listed in the table. Factor of corrosion acceleration of the SAE-1020 steel in galvanic contact with the alloys is given also.

Note that Hastelloys and chrome-nickel stainless steels, particularly those containing molybdenum, are resistant to attack. Galvanic contact with low carbon steel serves to reduce attack on these alloys at the expense of accelerated attack on the low carbon steels. Straight chromium stainless steels tested offered less resistance to attack; in fact, the free-machining Type 416 specimen showed a much lower resistance than the SAE-1020 steel.

Beryllium copper and hardenable monels were found to be low in their resistance when tested individually, but highly resistant when in contact with SAE-1020 steel. Note, however, that in the case of beryllium copper, the attack on the contacting steel was accelerated to four times the rate for the steel alone as compared to factors less than two for the chrome-nickel stainless steels. This must be considered in selection of valve trim material used in a steel valve body.

Practical application of Types 316 and 317 stainless steels as valve plunger material in steel boiler blow-off valves subjected to acid washing is based on a number of field applications to date. These confirm test results.

Variations In Acid

Repetition of tests with a fresh supply of inhibited acid, essentially the same composition, yielded results which varied considerably from previous values, although general order of corrosion resistance among alloys tested remained approximately the same. It was found that the source of cleaning acid was subject to varia-

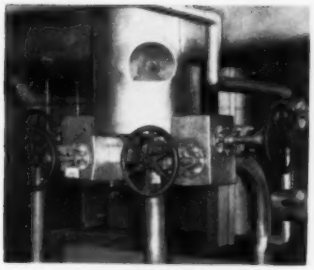


Fig. 3. Close-up view of installation of 2-in. tandem blow-off valve unit in a large central station

tion — some of the acid representing solutions previously used for chemical processing, but considered to be the equivalent of commercial acid for all practical boiler cleaning purposes. It is possible, therefore, that contamination resulting from such previous processing, together with other factors such as degree of aeration, could account for the noted variation in corrosion rates.

In general, when boiler cleaning solutions other than inhibited acid are used, materials resistant to the hydrochloric acid will be resistant to alternate solutions. They may not, however, represent the best materials for such applications. If corrosion rates are very critical, materials should be selected with regard to specific conditions encountered.

Other factors — hardness, resistance to erosion, accelerated corrosion of the valve body adjacent to trim material — are equally important in selection of desirable valve trim materials. When these requirements are especially important, materials exhibiting the best corrosion resistance may not be the most desirable. In over-all performance compromise materials may prove the most satisfactory.

Boiler *and* valves should be given the same neutralizing and flushing treatment after each acid wash. Failure to take this precaution could result in trapping of cleaning acid in valve cavities, causing corrosion over an extended period with resulting deterioration in excess of that normally anticipated.

Why Your Steam Traps Should Vent Air

By WILLIAM J. GLEASON, JR.

Manager, Steam Specialties Division, V. D. Anderson Co.

AIR REMOVAL from steam systems or steam using equipment is considerably more important than generally realized. Any steam compartment, before steam is turned on, is filled with air. Before steam can occupy this space, the air should be removed. If it is not, the steam entering the compartment mixes with the air and results in a lower heat value and temperature. This in turn lowers the heating efficiency of the unit. Furthermore, air is a very poor conductor of heat. If it is not removed, the entrained air insulates the steam from the heating surfaces, further reducing the heating efficiency of the unit.

Air removal is the only way to get quick heating-up of steam units. The faster the air can be removed from a steam compartment, the faster the compartment becomes filled with steam and the faster the unit will give off heat. On production units such as steam jacketed kettles, autoclaves, etc., where steam is turned on and off frequently, fast heating-up time reduces production costs. The quicker the unit heats up, the faster the production cycles, which means more work can be obtained from a unit during a given work day. This of course, substantially lowers the overall production costs. But even where production cycles are not involved, fast air removal is important if you want to stretch your plant's fuel as far as possible.

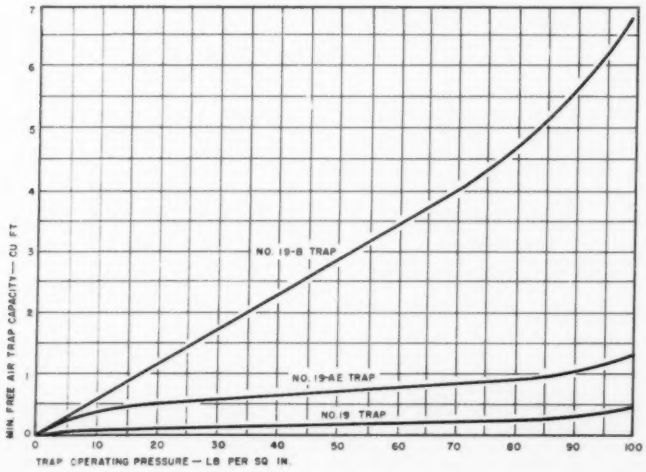
To illustrate the importance of air removal, take as an example equipment using a temperature control valve which is opening and closing repeatedly. Each time the valve closes the steam compartment becomes partly filled with air before steam is turned on again, which air must be removed when the steam valve is again opened.

In such a case, all of the air must flow through the trap. Consequently, a trap with a large air handling capacity should be used to vent the air as rapidly as possible. Usually when traps are sized, it is based upon the amount of condensate they handle with very little thought given to air removal. This sizing practice is natural, though incorrect, as steam traps were originally designed to permit the drainage of condensate without loss of steam, and no thought whatsoever was given to air removal.

As a result of this "steam trap heritage," very specific and accurate data are available giving the amount of condensate which traps will handle, and for sizing purposes tables are readily available showing the capacities in pounds of condensation per hour for any trap. Unfortunately, the air removal capacity is usually treated in terms of generalities with no specific information available.

Quick removal of air from your steam compartments depends upon the type of steam traps which are

Fig. 1. Curves showing the amount of air which can be handled by different types of inverted bucket traps



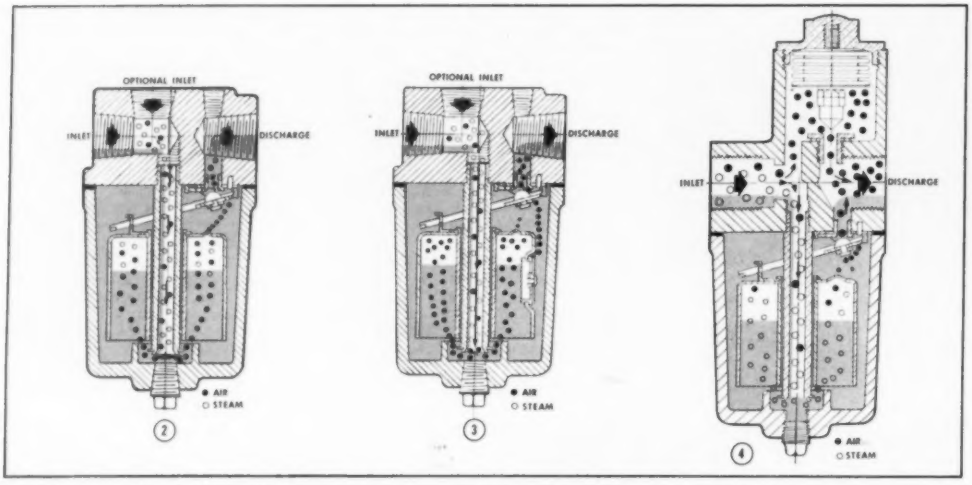


Fig. 2. Cross-section of standard inverted bucket type trap showing direction of air and steam flow

Fig. 3. A variation of the inverted bucket trap fitted with auxiliary air handling bi-metallic unit

Fig. 4. Variation of inverted bucket type trap with combination open float and thermostatic air by-pass

used. Figure 1 shows the amount of air which can be handled by different types of inverted bucket traps. These curves give the actual amount of air in cubic feet per minute which can be vented by these traps at the various pressures. The data for these curves is the result of tests conducted for these traps when handling air only.

The three traps tested and shown in these curves are the standard inverted bucket type traps, the inverted bucket type trap fitted with an auxiliary air handling bi-metallic unit and an inverted bucket type trap combined with a thermostatic air by-pass. (Figs. 2, 3, and 4.) It will be noted that at almost all pressures the combination trap is about three times as fast as the standard trap in venting air and the trap with the auxiliary bi-metalic air handling unit is about twice as fast as a standard trap. This is an indication that on applications where quick heating-up is required, or where large amounts of air must be handled gradually, the combination traps are a decided advantage.

A typical illustration of the rapidity with which air is handled by three types of traps is the draining of a pipe coil. The results of tests draining such a coil show that with the plain inverted bucket trap the coil heated up in 20 minutes. With the trap equipped with an auxiliary bi-metallic unit, the coil heated up in 10 minutes and with the combination trap it heated up in $2\frac{1}{2}$ minutes. These figures substantiate the venting times as given on the curves shown in Figure 1.

The advantage of the combination trap is in its use as an auxiliary orifice for handling the air separately. In the case of the standard trap, as well as the trap with the auxiliary bi-metal vent, all air must pass with the condensate down into the trap and to the condensate orifice. In other

Fig. 5. Installation view of inverted bucket trap

words, both the air and the condensate must pass through the standard trap orifice, or condensate orifice, which reduces the capacity of the orifice as this single orifice must be used for both air and condensate. However, with the combination trap the air is vented through the auxiliary orifice leaving the condensate orifice for condensate only. This results in increasing the air handling as well as condensate handling capacity of the trap.

By using this combination open float and inverted bucket trap, further advantage is gained in that the trap has two independent methods of handling air. One is through the bellows orifice; the other through the vent hole on the top of the bucket. The action, or operation, of this combination is as follows:

When the trap is cold the bellows valve is wide open and is capable of handling large quantities of air very rapidly. Incidentally, this is very beneficial since it tends to give a purging action and helps to minimize mixing of air and steam in the steam compartment. After the greater percentage of the air is vented through the bellows it will expand and close the vent. Subsequently, air is vented through the hole in the bucket. By this time, very little air is to be handled and the vent hole in the bucket is of ample capacity. This relieves the bellows of the necessity of opening and closing frequently and consequently increases the life of the bellows considerably.

Rapid air removal from steam systems will not only result in quicker heating-up and increase production but will also reduce corrosion to a degree. This is found to be the case particularly on unit heaters where air which is not vented rapidly will cause corrosion and consequently cause the unit heaters to leak.

The Wandering Discs

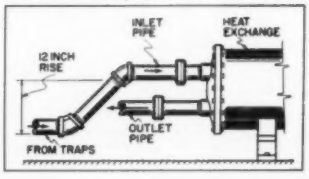
By THOMAS TRAIL

A SHELL and tube heat exchanger opened for examination and cleaning yielded three metal discs from one of its end chambers.

Inspection showed these were valve discs of a type used in several large steam traps draining nearby storage hot water heaters.

It was within the realm of possibility that the parts could have found their way into the heat exchanger, but it did seem strange in this case that the heavy parts (one weighed more than $\frac{1}{4}$ lb) could have been forced through a rise in piping shown in the sketch.

Discs found their way up a 12-in. rise in the pipe



Boiler Explosions Like This

This shows explosive potential of unburned fuel oil taken too lightly resulted in serious boiler damage

Can Be Prevented

BOILER EXPLOSIONS, like that shown in photo taken from the *Factory Mutual Record*, can be costly and dangerous — and avoidable. In this case, the flame in an unattended boiler heater failed shortly after it was fired. Explosive vapors accumulated and ignited 5 min later, possibly from a hot burner throat or glowing carbon.

Flame failure controls could have prevented this explosion. Sometimes called Combustion Safeguards, they are control devices that sense the presence of flame, and, if the flame fails, shut off the fuel and sound an alarm. When firing fuel oil, as was the case in this boiler, a photo-electric type control can be used.

A large measure of safety for a small cost would have prevented this particular boiler disaster.

How 50 Generating Stations Handle Chlorination

INDUSTRY is faced with two problems regarding water supplies. The first is an adequate supply. The second is the purity of the supply. With increased industrialization and concentration of populations, the increased demand for water can only be met by utilizing surface water from lakes and streams. These surface supplies introduce micro-organisms which form organic slimes which coat heat transfer surfaces and clog cooling towers. Chlorination of this water is one method which has been adopted as a control for this problem.

A questionnaire on the chlorination of cooling water was recently distributed to all of the members of the Power Station Subcommittee of the Prime Movers Committee, Edison Electric Institute. Replies to this questionnaire were received from 23 operating companies, representing 50 generating stations. The results reported in the EEI Bulletin publication No. 51–9 show some interesting facts regarding algae content, corrosion, methods and frequency of water treatment, and the most effective methods of treatment.

Algae conditions were reported at every station except one. This condition was classified as slight at 19 stations, moderate at 29 others and severe at one station.

Corrosion

Corrosion conditions were reported as severe at two stations, moderate at nine, slight at 30 and non-existent at six. All companies but one reported no increase in corrosion nor shortening of tube life due to chlorination treatment.

Non-chlorination Stations

Six companies reported no chlorination treatment in use at a total of

Table showing type of heat exchanger tube metal and its service life, for a number of installations

Material	Approximate Use Reported	Of Which Amount	Has Service Life Over
Admiralty	40.8%	36%	15 yr
Arsenical Copper	20.2%	47%	10 yr
Muntz	12.9%	47%	15 yr
Aluminum-brass	11.5%	40%	10 yr
70% Cu-30% Zn	7.2%	72%	18 yr
Miscellaneous	7.4%	..	..

nine stations. Regarding maintenance of condenser vacuum, two of these companies gave the standards and cleaning methods used to attain them at five stations.

Liquid Chlorine vs Hypochlorites

Liquid chlorine is used at 28 stations, and one other station planned to adopt it to replace a radically different treatment method. Sodium hypochlorite is used at six stations and calcium hypochlorite at six other power stations.

Analysis of the questionnaires failed to reveal any clear relationship between the sources or characteristics of the various waters and the relative efficacy of liquid chlorine vs hypochlorites which were used.

The replies indicated very wide variations in practice with respect to the concentrations used, the duration of the treatment periods, and their frequency. The degree of treatment used does not, in many cases, appear to be related to severity of algae condition nor to water temperatures. More extensive study of this subject might lead to recognition of standards which would permit future significant economies in this field.

Point of Injection

All chlorination, with two exceptions, is done during operation, by injecting the chemical into the cooling-water inlet, usually at a point upstream from the pump suction.

One of these exceptions concerns one station's practice of supplementing the above treatment by periodical use of the *soak* method when the units are not in operation. The other concerns a station in which a *back flow* method is utilized on its larger condensers with the units off the line.

Practically all the reporting stations increase the degree of chlorination in the summer months, and all but one station accomplished this by increasing the frequency of treatment during this period.

Subcooling was reported under winter operating conditions by 26 stations, and by 17 stations for summer operation. Zero subcooling was reported by 10 stations under winter conditions, and by 18 under summer conditions. The maximum subcooling reported for winter operation was 14 F and the average was 4.35 F for 24 stations. For summer operation, the maximum subcooling reported was 10 F and the average was 2.5 F.

Condenser-Tube Composition

Condenser-tube composition was reported for all stations, but in varying detail. As the capacity of the stations and individual units were not covered in this questionnaire, the data for "Approximate Use Reported" in the first column of the following table must be regarded as indicating preference only. Also, as not all companies reported service-life data in detail, the figures in table on this subject are to be taken as minimums. Naturally, alloys which have found only comparatively recent use cannot have achieved the length of service of the traditional Admiralty and Muntz metals.

Data on tube failures were included in only a very few reports and, in many cases, only the life of the condenser units was given since no failures have occurred. Condenser-tube composition and service life in condensers may make an interesting and constructive study at a later date. At present, many units have been in service too short a time for the presentation of a conclusive report.

No attempt was made to evaluate analyses of deposits found on condenser-tube surfaces, since less than 30 per cent of the stations reporting submitted any data on such deposits.

Typical analyses of cooling-water supplies were included in reports on about 60 per cent of the stations.

Discussion of Treatment Methods

Sodium Hypochlorite — All the six stations using sodium hypochlorite treat for a single 30 min period daily, maintaining a residual concentration of 4 to 10 ppm. They all use salt water for cooling. All are located within a very few miles of one another and are subject to relatively similar conditions.

Calcium Hypochlorite — Six other stations use calcium hypochlorite. Two of these are in the same system and immediate area as those using sodium hypochlorite and use the same schedule and similar concentrations.

The other four are in a single system. Two of them utilize water from a lake and use an entering concentration of 0.7 ppm and a one-hour treatment period, weekly or semi-weekly, to control an algae condition reported as slight. Two stations utilize water from a tributary river; both report a moderate algae problem and both use an entering concentration of 5.0 ppm, which gives a residual of 1.0 to 3.0 ppm. However, one of these stations treats for a 20-min period every 1 to 3 days, and the other uses a 6-min treatment every two hr during the summer and operates noncondensing during the winter.

None of the six stations has especially high summer water temperatures, and deviations are reasonably small and consistent.

"That red warning hand on that control is quite something, isn't it?"

Liquid Chlorine — Among the 28 stations using liquid chlorine, the variation in treatment concentrations and schedules is much wider. The maximum concentration is 15 ppm residual, used daily for a 30-min period in a large station cooling with salt water. For comparison of four other salt-water-cooled stations, three use a residual of 0.5 to 0.75 ppm two or three times a day for 4-min periods, and the other uses a residual of 0.3 to 0.7 ppm (1 to 7 ppm entering) for 12-min periods every two hr.

The concentrations used by the other stations fall into two ranges. Fifteen stations use from 0.4 to 1.0 ppm entering, or from 0.1 to 0.7 residual, and the other seven stations use from 2.0 to 8.0 ppm entering, or from 1.0 to 3.0 ppm residual. The length of treatment periods varies from 5 to 30 min and their frequency from once every 1.5 hr to once every three weeks. In general, of course, the more frequent schedules are for relatively short treatments at relatively low concentrations, but there is no consistent relationship between these quantities in present practice.

Most Effective Methods of Treatment — There is no general agreement in the industry regarding the most effective concentrations and schedules for different water conditions. It appears that closer control of chlorination operations could be effected by the use of adequate residual chlorine limits, rather than by controlling the concentration of chemical entering the condenser. Excessive overtreatment could then be minimized.

Conclusion

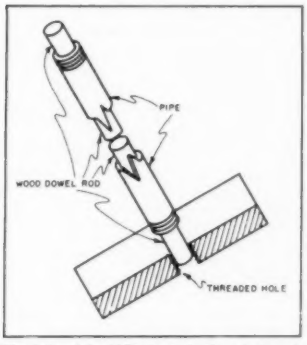
Factors other than those covered in the questionnaire must be taken into consideration. Among these may be such items as capacity of stations and units involved, availability of the units, and general station layout.

This subject merits further study because of the economies which might be attainable, not only in the cost of treatment, but more particularly in improvement of operating efficiencies as a result of the maintenance of much better vacuums.

PRACTICAL HINTS AND KINKS

Starting Pipe Thread

WHERE PIPING must be threaded into tapped holes that are out of sight, a length of suitably sized wood dowel rod, as shown, will simplify the procedure. The dowel rod is first fitted into the threaded opening.



Wood dowel should fit pipe to be threaded snugly

Then the pipe is slipped over the rod and moved against the face of the opening. By raising the rod slightly, the end of the pipe can be brought into location for threading, after which the rod is withdrawn.

Use Graphite to Pack Tube

By W. E. WARNER

FOR packing tubes, when bending them, flake graphite is a good material — combined with springs. Graphite is soft, packs readily and, being dry, can be easily removed by blowing it out. Graphite packing is only used in the section of pipe to be bent; for the two ends, long spiral springs are inserted. At the end of these rubber pads, slightly larger than the internal diameter of the pipe, should be used to prevent the graphite from being pushed out by the bending pressure. The springs are held compressed by wood plugs in the pipe ends.

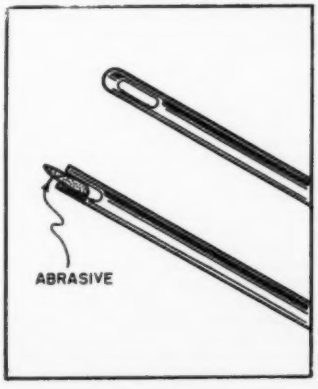
Small Glass Drill

By R. F. CLOTHIER

YOU MAY seldom need to drill a small hole in glass, but when the occasion arises the following method is an excellent and inexpensive one.

Choose a sewing needle whose diameter is less than the size of the hole to be drilled. Grind off the end of the eye to form a little "fork." Then wedge a small crystal of carborundum or alundum into this "fork." This usually secures the crystal firmly enough for most purposes, as shown in the sketch.

Grind down eye of needle and fix abrasive in slot



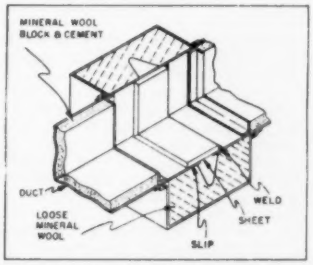
A more permanent mount can be obtained by heating the end of the needle containing the carborundum flake and touching a little plumber's solder to it. While warm wipe off any excess. A few practice drillings will wear off any coating of solder on the crystal.

Although water can be used as a lubricant, a saturated solution of sodium bicarbonate is better. Turpentine, which is usually obtainable, is best.

For larger holes slot the end of a piece of drill rod and insert a carborundum chip of suitable size. The above procedure is then followed.

Insulate Expansion Joints

HEAT LOSS at expansion joints of ducting can be prevented by a simple insulating technique.



Mineral wool blocks insulate the joint enclosure

This comprises construction of a light-gage metal box over the joint as shown in the illustration. One edge of the box is so made that it can bend in and out as the joint contracts or expands. The box is filled with loose mineral wool to prevent heat loss. Depth of the box depends on the temperature of the duct.

Ducts can be insulated internally and externally, depending on duct service. The box, of course, circumscribes the complete perimeter of the duct.

Water Hammer in Steam Lines and Equipment

By H. D. FISHER

REALLY SERIOUS thought and investigation devoted to water hammer in steam lines and other steam equipment appears insignificant compared with difficulties arising from its even occasional occurrence. Very little has been written on the subject — for instance in indexes of ASME Transactions covering 70 years of publications, there is just one reference, a note by Thurston in 1883.

Editor's Note: Observe that author is talking here about water hammer in steam *equipment. A great deal of work has been done on water hammer in lines and equipment carrying cold or relatively cold water. The literature of the hydroelectric field, on water hammer in penstocks, is extensive, also the work in analyzing pump pulsations and the like.*

General attitude regarding water hammer seems to be that it results from improper drainage of condensate, that it is something to be ashamed of, and that it should not be allowed to happen in a properly run plant.

Role of Steam Pressure

One problem requiring attention is the relative susceptibility of equipment operating with low and with high pressure steam to water hammer.

There seems little doubt that water hammer is more frequent with low pressure steam, but there is plenty of reason for this in the circumstances of principal applications. Most high pressure steam is used for purposes other than heating so that piping and equipment are designed to minimize condensation and to facilitate removal of condensate as quickly and completely as possible. Therefore, there is very little water available to create a water hammer. Further, in contrast to much low pressure equipment, in many of the higher pressure heating installations, such as feedwater heaters of a regenerative turbine cycle, heating steam is not confined to pipes or coils to produce the guided flow necessary to produce a water hammer. In most low pressure heating equipment, aside from direct contact heaters, the steam is supplied inside of tubes or coils to facilitate the handling of processed material, be it air, water, dye or soup, and the form of the enclosure is ideal once other necessary conditions for a water hammer occur.

Then, too, with high pressure steam ample pressure is available to force out condensate, even though trap valves may not open fully or pipes are partly clogged. With low pressure steam a comparatively small drop in pressure may produce a very large percentage reduction in the differential available to force condensate out under similar conditions or even against an unusual hydrostatic head on the discharge side.

Fundamental Condition

Discounting all these things, it seems to me that there is a fundamental thermodynamic condition making water hammer more likely with low pressure steam. On the basis of the generally accepted hypothesis that water hammer is caused by formation and subsequent sudden collapse of steam bubbles in a body of water, due probably to minor pressure variations in the system disturbing the steam — water equilibrium — consider the following:

Assume a mixture of steam and water in a pipe or tube in equilibrium at a pressure of 2.3 psig or 17 psia. Also assume that a temporary drop in pressure of 1 psi occurs. Saturation temperature at 1.3 psig will then be 216.3 F as compared with 219.4 F, and flash steam will be formed by Btu available between the two pressure conditions — that is, 187.5 minus 184.4 or 3.1 Btu per lb of condensate. Flash steam formed will amount to 3.1 divided by 967.6 lb or 0.0032 lb of steam per lb of condensate. This steam will have a specific volume of 24.8 cu ft per lb and the flash steam per lb of condensate will have a volume of 137 cu in., or about 4.7 times the volume of the pound of water from which it was formed. Formation of this steam will drive some of the water along the pipe and momentum acquired by the water will carry it beyond the point of equilibrium causing formation of more steam with further cooling of the water until the saturation temperature in that portion of the system is lowered below that of the remainder of the piping system, water tubes or in whatever environment this occurs. The displaced water then starts to return with increasing momentum and velocity, compressing the vapor which has just formed so that its saturation temperature is raised and its rate of condensation accelerated until it might be said the steam bubble suddenly collapses and the impact of water on the two sides causes sudden rise in pressure known as a water hammer. It must be understood that these are transient, dynamic phenomena and must be considered on the basis of rapid transformations of small amounts of energy rather than as a continuous state of more or less static conditions.

With high pressure steam of 100.3 psig or 115 psia, a 1 lb pressure drop will lower saturation temperature from 338.1 to 337.4 F, and the heat available will be 309.0 minus 308.3 or 0.7 Btu per lb of condensate. This would evaporate 0.7 divided by 880.4 lb of steam which at the specific volume of 3.91 cu ft per lb would occupy only 5.4 cu in. Thus there is comparatively little volume change to initiate the processes described for the low pressure steam.

An example of trouble caused by water hammer may indicate that it is more common than is generally recognized.

In order to improve the temperature control of water supplied for process work, a U-tube heating element with a thermostatically controlled steam valve was installed in a process water storage tank, converting it into a storage type hot water heater. Tubes of the heater were 1-in. OD, No. 16 BWG copper on a square tube spacing with vertical lanes. Straight portions of the tubes were horizontal and located near the bottom of the tank. The tube plate bolted to a flange on the end of a neck on one head of the tank. Steam and condensate passages were formed by a domed head with a horizontal partition and 3-in. flanged openings with faces vertical.

A Typical Case

After a comparatively short period of operation it was noticed that condensate was contaminated by process water. The heating unit was removed for inspection and it was found that the lower row of tubes for a distance of 6 to 9 in. from the tube shut were swelled to 1¼ in. or more in diameter and several had split. Although no sound of water hammer had been heard, it seemed to be the only possible explanation, since it was perfectly possible that these tubes should be wholly or partly flooded at times and the thermostatically controlled steam valve provided plenty of pressure variation.

The outer row of tubes were cut off and the tube holes plugged. To insure better drainage a 3-in. flanged elbow was bolted to the condensate discharge opening with the end looking down a 3-in. pipe, 3-ft long, bolted to it to provide a condensate reservoir. The drainage trap was arranged to discharge to atmosphere. The heating coil was put back into service but in a comparatively short time the condensate was again found contaminated and the next row of tubes, now the bottom row, were found swelled and split in a manner similar to the first ones. The difficulty, probably heightened by the regulating valve, seemed incapable of solution. For that reason, a shell and tube heater with water inside the

tubes and steam in the shell was substituted, at the expense of some temperature control.

Temperature Difference

Other experiences indicate that vertical tubes will clear themselves of condensate more readily. If, however, such units are installed with a common condensate drain line, each unit must be trapped separately or have a check valve installed on its drain line to prevent backing up of condensate from other units. It is rather surprising but, in a large hot air system with several units in parallel across the suction of the fan and apparently large inlet connections for steam at 20 psig, the condensate temperature from the center units was 3 to 4 F lower than from the side coils. A pressure difference such as indicated by this temperature difference would maintain quite a substantial difference in condensate levels in the drain ends of the coils. In this instance there was constant water hammer and leaky pipe joints until this temperature difference was discovered and check valves installed.

Maintenance of Organic Insulation in Circuit Breakers

ORGANIC INSULATING MATERIALS are used extensively in high voltage indoor type air circuit breakers for pole unit supports, operating rods, barriers, braces, arc chutes and similar purposes where it has been found to be more suitable than porcelain. The material often used is micarta which has a long established record for insulating and mechanical dependability. To ensure long continued electrical resistance the micarta surface is protected with high grade insulating varnish which may be either clear or pigmented depending upon the place of use and the apparatus design requirements. The purpose of the varnish is to retard moisture absorption and to provide an easily cleaned surface. Like all other insulating surfaces, whether organic or inorganic, a varnished micarta surface should receive periodic maintenance in order to maintain the insulation resistance at the highest possible value.

The objects of maintenance are two-fold: first, to remove dust and other foreign air borne materials as well as chemical oxides which result from aging of the varnish, and, second, to make sure that the varnish provides a continuous protective film over the entire insulating surface according to *Westinghouse Maintenance News*.

After breakers have been in service for three to five years the insulation should be inspected and cleaned and the varnish renewed if the surface indicates this is needed.

Cleaning Is First Step

While the surface of the insulation is dry, dust and varnish oxides do not usually cause any large change in insulation value. However, if, while they are present, moisture is added in the form of condensation or by more direct means, the surface electrical leakage may be greatly increased even to the point of electrical breakdown. The first object of maintenance, therefore, is cleaning. A clean varnished surface will be smooth, glossy and free from foreign material, either loose or adhering to the surface. To obtain a clean surface it is necessary to loosen the adhesive dirt by scrubbing and washing. This is best done in the following manner:

1 — Wash with normal heptane obtainable from the major oil companies such as Esso Standard. Use clean paper towels wet in the heptane. Use a fresh towel on each part. *Caution: Heptane is flammable and no open flames or sparks should be allowed near the work.*

2 — After the heptane has evaporated, which requires only a minute or two, wash with de-ionized water, sometimes called demineralized water or distilled water.

NOTE: De-ionized or demineralized water can be obtained in small quantities from many firms that maintain chemical laboratories, particularly storage battery manufacturers or electroplaters. Keep the water in a handy size glass bottle. Wet the towel from the bottle, wash the part and dry with a fresh towel.

In inspecting the insulating parts preparatory to cleaning, wipe off superfical dirt with a dry cloth and note the condition of the varnish and of the micarta. If the varnish appears in good condition, i. e., fairly smooth and with liberal coverage, proceed with cleaning.

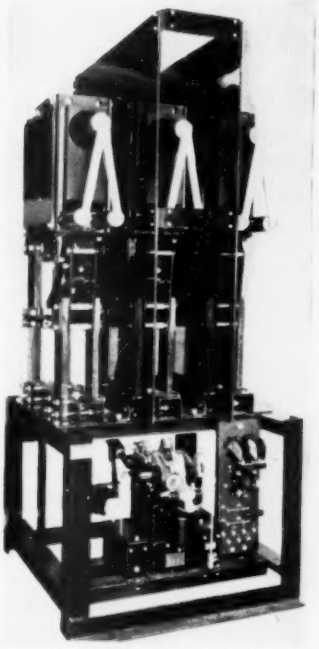
If the varnish appears thin and is not uniform in coverage, is cracked or can be peeled off with the fingernail, the parts should be revarnished.

This can be done with the parts in position on the breaker as follows:

1 — Sandpaper when needed to remove loose varnish and wipe off all dust from sanding.

2 — Apply three coats of varnish. Allow 24 hours drying time between coats at ordinary temperatures. Drying time may be decreased by preheating parts with infrared lamps to a temperature of 40 to 50 C before applying varnish and likewise heating each coat for about 4 to 8 hours or until the varnish has set up to the point where it will not be lifted by applying the succeeding coat.

Some of the breakers, particularly those built prior to 1939, have wood micarta pole unit supports while others have paper micarta supports.



Micarta insulation of the De-ion air circuit breaker needs periodic maintenance as described in the text to give the best insulating performance

The same varnish treatment is satisfactory for either. In inspecting the parts prior to cleaning or varnishing, cracks may be found running lengthwise or parallel to the laminations of the material. These may be more prominent on the wood micarta parts than on the paper material.

If these cracks are very small and do not extend into the material much beyond the surface, they do not represent a hazardous condition but the parts should be revarnished.

In a few cases the cracks may be relatively wide and extend deep into the material. The safest procedure in these cases is to replace the parts with new factory finished parts.

Obviously it is impossible to describe exact limits as to which cracks are harmless and which indicate need for replacement. If in doubt, revarnish the parts. If the cracks are practically filled, the parts may be left in service.

Questions and Answers

Your fellow engineers will answer your power plant questions. You answer theirs, get paid well. Simple? Effective? Just try it!

Answer No. 493

How Can He Stop Dirty Spray from Blow-Off Tank Vent?

On H.T.L.'s blow-off tank, the vent pipe rose 80 ft to discharge above the roof. The discharge was a dirty rain storm, leaving black spots on everything around. How could he stop the trouble? Several good practical solutions were given in the June issue. Here are others.

Comments By Evans

IN ORDER to size the tank, see sketch, a disengagement steam velocity of 400 ft per min maximum is recommended. To calculate tank diam the maximum rate of blowdown must be determined by test or approximation. The per cent of flash steam is determined as follows:

$$\text{Per cent} = 100\left(\frac{H_s - H_b}{V_b}\right) = 100\left(\frac{H_s - 181}{969.6}\right)$$

Where H_s = heat of liquid at boiler pressure; H_b = heat of liquid at flash pressure (181 Btu per lb for atmospheric flash); and V_b = latent heat of evaporation at flash pressure (969.6 Btu per lb in this case).

Then, lb per min of flash steam =

$$\text{per cent of flash steam} \times \frac{\text{wt measured}}{\text{min}}$$

Cubic ft per min =

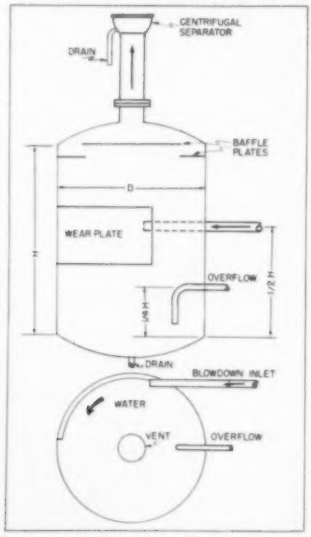
lb per min of flash steam x sp volume for atmospheric flash; or lb per min of flash steam x 26.3

The diameter of the tank =

$$\sqrt{\frac{\text{cu ft per min}}{0.785 \times 400}} \text{ or } \sqrt{\frac{\text{cu ft per min}}{315}}$$

A centrifugal separator is a must!

Chicago, Ill. MELVIN EVANS



Proper sizing of the blow-off tank is important

Comments by Moulton

H.T.L.'s ORIGINALLY designed tank seems good — large enough for a good sized boiler plant of moderate pressure. The perforated diffuser pipe on the blow-off inlet pipe discharging under water is correct in principle, and should allow hot blowdown to discharge with the least possible disturbance. It would seem that any solid matter discharged would be separated and deposited in the water of the tank.

Overflow and vent pipes seem functional — and even if this failed to stop dirt, it would appear that the modified tank with its large perforated collector cage and long stack pipe would surely separate the troublesome dirt from the steam. The fact that it did not would indicate that solid matter discharged may be residue of boiler compounds or solids precipitated in boiler water, deposited when steam condenses. If this is so, separating devices such as exhaust steam separators are not effective in removing dirt. As long as the flash vapor remains as steam, dirt will be carried along and be released only when the steam condenses.

Apparently the thing to do is to condense this flash steam as it leaves the blow-off tank by discharging it through some form of condenser, such as a heavy spray of water or a jet condenser. The jet would probably be most effective. It could be of barometric or low-head type with removal pump. The type to use would depend upon the situation of the plant, climatic conditions and allowable cost.

Cost of the condenser could be offset by a more simply constructed blow-off tank. Of course, if a condenser is used a back-pressure relief valve would be needed to prevent over-pressure in the tank in case of failure. A vacuum breaker to limit vacuum produced by the condenser to a few inches would also be needed. The overflow tail pipe should have enough fall to overcome the vacuum. Capacity of the condenser need not be large, as the total amount of water flashed into steam is only a small part of the total discharge. For example, at 200 psi the amount flashed to 5 psig would be about 19 per cent.

If 1060 lb per min is discharged into the tank, the amount flashed at 200 psi would be 190 lb per min. Since high vacuum would not be required, the amount of condensing water required would be small. For example, if the discharge temperature was 150 F, the amount of condensing water at 60 F would be about 275 gpm during blowdown.

Pittsfield, Mass. A. H. MOULTON

Answer No. 497

Should He Install Additional Deaerator?

IN MAY, J.G.D. said he was increasing his steam generating capacity from 80,000 to 120,000 lb per hr. So — could he add a 40,000-lb-per-hr deaerator to make up the difference or would he have to install a new deaerator for the whole 120,000?

Moulton Shows Calculation

DATA GIVEN for J.G.D.'s new heater capacity are: 120,000 lb of steam per hr; steam pressure, 5.3 psig; feedwater temperature, 228 F; condensate, 200 F; make-up, 60 F; with 60 per cent condensate and 40 per cent make-up.

Then enthalpies are: of steam, 1156.3; of condensate, 168; of make-up, 28; and of feedwater, 196 Btu per lb.

Heat release from 1 lb of steam is 1156.3 minus 196, or 960.3 Btu per lb. The heat absorbed by 1 lb of condensate is 196 minus 168, or 28 Btu per lb. Heat absorbed by make-up is 196 minus 28, or 168 Btu per lb.

Then as steam used to heat the feedwater is condensed in the water, it becomes a part of it, so that 1 lb of feedwater is made up of three parts, the percentages of which are proportional to heat content of each part.

Then the maximum make-up flow is 85.1 per cent (960.3 divided by 168 plus 960.3) and the maximum condensate flow is 97.2 per cent (960.3 divided by 28 plus 960.3). The maximum make-up would be 120,000 times 0.851, or 102,120 lb per hr. Maximum condensate would be 120,000 times 0.972, or 116,640 lb per hr.

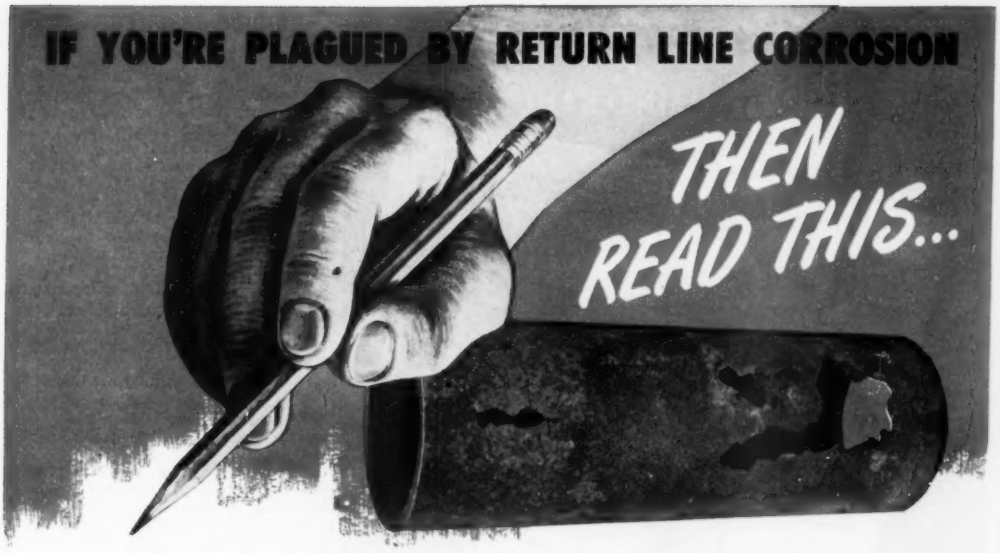
Maximum steam flow will be 120,000 minus 102,120, or 17,880 lb per hr, with maximum make-up flow and zero condensate flow. Minimum steam flow would be 3360 lb per hr with maximum condensate flow and zero make-up.

Then, from the Heater State Triangle, explained in the article, Graph Your Deaerator Heat Balance, POWER ENGINEERING, December 1951: with 60 per cent condensate or 72,000 lb per hr, make-up flow is 39,000 lb per hr with a steam flow of 9,000 lb per hr. With 40 per cent make-up or 48,000 lb per hr, condensate flow is 62,000 lb per hr with a steam flow of 10,000 lb per hr.

At 80,000 lb per hr rated capacity and with 60 per cent condensate or 48,000 lb per hr, make-up flow will be 26,000 lb per hr with a steam flow of 6,000 lb per hr. With 40 per cent make-up or 32,000 lb per hr, condensate flow will be 41,500 lb per hr with a steam flow of 6,500 lb per hr.

It would seem advisable to get a deaerating heater of at least 120,000 lb per hr, or even larger to provide for increased capacity later. Reducing valve size should be about 6 in. with a 10-in. schedule 40 pipe running to the heater.

Pittsfield, Mass. A. H. MOULTON



As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

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PE

Turbine Maintenance

(*Continued from page 65*)

include the horizontal and vertical vibration values on each bearing housing, transverse and axial on any extended governor housing and horizontal and/or vertical on each point where it is possible to make contact on a polished section of the main shaft.

A partial log sheet form is shown as Fig. 3. This is designed to be made up on 5 by 8 in. cards or 8 by 9½ in. folders of strong paper.

The 16 columns allow for entering:

(1) The all-time best set of readings (dated)
(2) The last previous readings (dated)
(3) Current readings as taken.

The reverse side should be used for brief records of work done and conditions found that influence vibration values.

The reading for each location should be taken from the same exact spot and the same type instrument. When extra readings are taken by special methods, some identifying notation is necessary.

Spots where these readings are to be taken require marking. A small circle, stenciled on, is satisfactory.

So far as possible, readings should all be taken at uniform load, not less than one hour after a unit has been stabilized at that condition. Units on varying load may require groups of readings to establish a firm basis for any special maintenance activity.

What Readings Show

A modest change in vibration readings may be significant, particularly on units normally very smooth. A definite increase of 50 per cent in vibration values anywhere on such units should receive careful attention. The total vibration even then may only amount to 0.0015 in. to 0.002 in. and is not ordinarily alarming. But definite change is significant.

On units with a basic vibration level of 0.002 or 0.003 in., changes of 0.0005 in. are not as significant. However, a 50-per cent increase on such a unit would start sympathetic vibrations that could not be tolerated. Oil pipe breakage is one of the serious hazards involved at this point. In addition, the natural damage in bearings, governor drive gears, oil deflectors, packing, and so on, would be a serious matter.

These effects are superficial, whereas the basic cause of the vibration may be, and frequently is, the beginning of complete failure of one or more rows of buckets or blades.

Vibrations of many types and frequencies other than those at shaft speed often occur. The writer has found as many as five frequencies of different magnitudes of vibration with the predominant one not at main shaft speed. A frequency sensitive instrument is often required to trace such effects to their source. On

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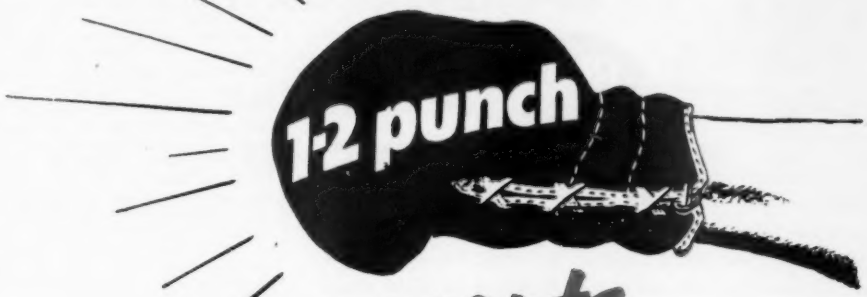

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Removes grease-type slushing compounds. Carries away harmful abrasives. Protects against rust.

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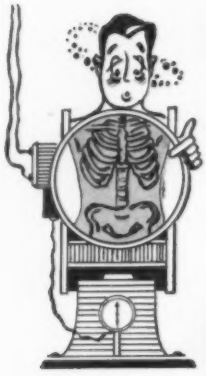

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FIG. 811

FIG. 811

This vane-type Bowser Indicator is spring-actuated, thus providing an indication of the quantity flowing in the line.

FIG. 54A

This Bowser Flow Sight is recommended for use on gravity lines where the flow is vertically downward.

FIG. 54A

FIG. 816

FIG. 816

The Figure 816 Bowser Teleflo Indicator is equipped to operate a gong or to stop pump motor if liquid flow stops.

Consult with the Bowser engineer nearest you.

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3600-rpm units, there is also a double-frequency armature vibration that is easy to identify. On old units this is inherent and must be lived with. Newer units with flexible armatures should not telegraph much of this to other parts. If it happens, a frequency sensitive device is helpful in finding the contact spots.

For everyday vibration readings, this writer considers the inertia-mounted dial indicator the most practical. The illuminated-dial, expanded-scale instrument is preferred by some. While it is best to have the official readings taken by the same individual as well as the same instrument, there should be men on every operating shift capable of doing it for the purpose of quick checking of transient conditions.

Rubs: — Closely associated with vibration determination is the matter of "rubs" in a unit. Operators should use listening rods, Fig. 2, systematically even on high-temperature parts of units where they are the least effective. An unusual sound plus unusual vibration is much better evidence than either one alone. Most electric listening devices are too sensitive.

Bearings and Lubrication

Older turbines were built with relatively large bearing areas and not too large a flow of oil in gallons per minute. Trouble in such bearings would show up in a noticeable change in *rise of temperature* of the oil.

Newer units are likely to have very much smaller bearing areas but a great deal more oil flowing, so trouble is likely to be more serious before temperature changes become definitely noticeable. This means that oil temperature rise should be watched consistantly and critically for all bearings where this information is available. Oil temperature records are important log sheet items.

Routine, frequent observations should be made of the general appearance of the oil in important units, continually on the unit itself, and weekly by drawing a sample from somewhere on the bearing supply header into a clean, cylindrical 8-oz sample bottle. This should be allowed to settle a few hours to get the water, if any, down. Particles of metal from gears and the like, as well as water, are frequently detectable in such samples.

Similar 8-oz monthly samples from all circulating oil systems should be checked in a chemical laboratory for acidity — moisture and sediment and the sediment should be examined for dangerous metal particles, especially on new units and after overhauling or other major repair work. Welding spatter is especially dangerous.

General discoloration of oil: — This may come from various influences. A tendency to develop sludge will probably show first as a grey cloudiness, then may develop into an orange color as the oil deteriorates.

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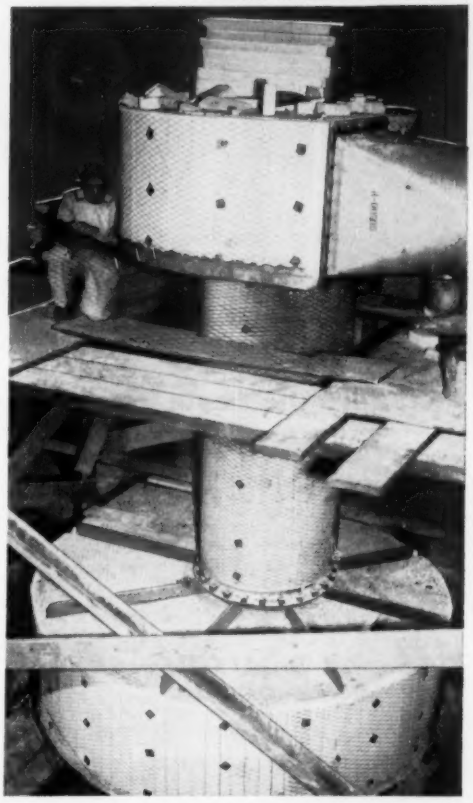
WITH ADVANTAGES...

Leading Utilities Are Switching to KAYLO HEAT INSULATION



1 A Better Basic Material. Kaylo Heat Insulation is hydrous calcium silicate — a revolutionary material (not glass) developed after many years of research. Proved in thousands of field installations, it combines to a high degree the most desirable physical qualities of heat insulating materials.

2 Outstanding in Performance. Kaylo Heat Insulation has a wide effective temperature range —up to 1200° F.—thus eliminating the need for combination coverings in nearly all operating conditions. The material's unique cellular structure, composed of countless sub-microscopic dead-air spaces, provides high insulating value. It remains efficient and stable through years of service. Even when saturated with water, Kaylo Heat Insulation retains about 85% of its strength. It regains its normal strength and insulating efficiency after drying. It has high flexural strength, compressive strength and resistance to impact and abrasion. Workmen can walk on insulated equipment without causing breakage.

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NEW JUSTIN R. WHITING STEAM POWER PLANT of Consumer's Power Company located near Erie, Michigan. Included are two Babcock & Wilcox boilers with a rated output each of 690,000 lb. per hr. at 1480 psi. and 1000° F. Each boiler supplies one 85,000-kw turbine-generator for total of 170,000 kw. More than 20 carloads of Kaylo Heat Insulation are used in this installation.

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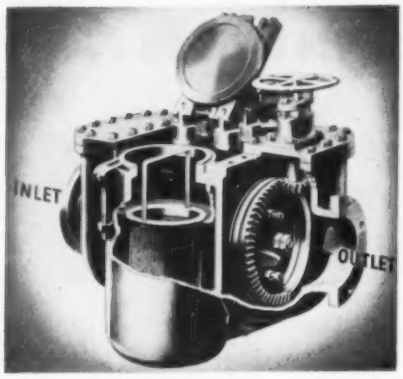
R-S Duplex Strainer



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- **CLEANED UNDER FULL FLOW!**

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  Designed for minimum pressure drop and low maintenance, the R-S Duplex Strainer is available for nearly all liquids in 4-inch to 24-inch pipe sizes. Has no equal for efficient heavy industrial service.

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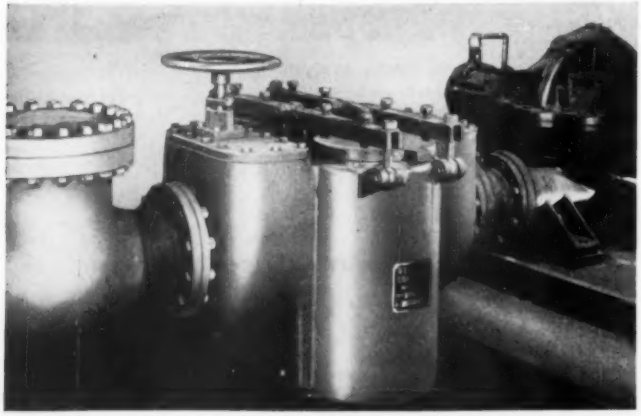


The grey cloud is in itself a sign of moisture. This combines with the inevitable admixture of air and various impurities to contaminate the oil and form sludge, which blocks up oil passages. The deterioration of the oil becomes progressive and ultimately it may become unstable and capable of completely emulsifying.

A general darkening of mineral lubricating oil is quite likely to be due to metal in an extremely fine form — (fullers earth filtering may not clear it up) — this is more likely to come from bronze parts under static pressure load, such as occurs in bronze-bushed floating coupling pins, than from worm gears or normal bearings.

Reason for signs of distress in any batch of lubricating oil should be determined and remedied promptly, for a tendency to emulsify indicates a possibility of *foaming up* enough to permit bearings to make metal to metal contact.

Local Overheating

Local overheating in bearings is frequently detectable during inspection, even though the indicated discharge temperature is reasonable. Changes in oil connections or in point of application and, in some instances, simple changes in the babbitt surface pattern have cured very troublesome cases. (Some of these cases required frequent rebabbitting, some caused unpredictable failures, some simply destroyed oil.)

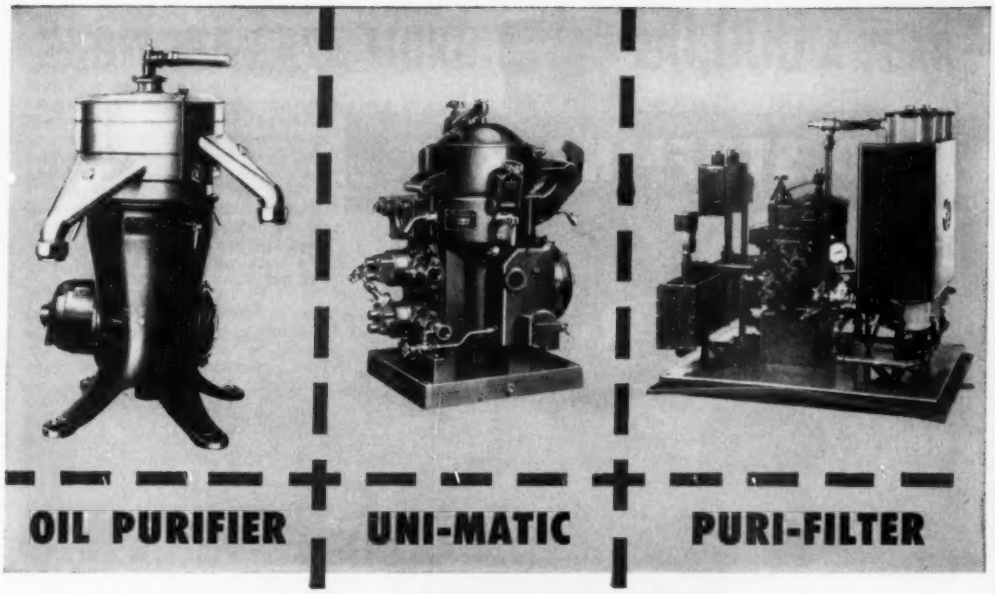
Clean oil a must: — A long chapter could be written on ways and means of continuously clarifying circulating oil. Let us say here, however, that a carefully-designed slow-motion oil cycle will preserve oil for many years and that old systems are often capable of modifications to obtain similar results. Clean, clear oil is a necessity on orifice-controlled governing devices.

Another present-day hazard is that of washing out of inhibitors, particularly the so-called *wetting agents*. Laboratory tests sometimes detect the condition before any harm is done. If a *frequency-of-wash-out* rate can be determined, some oil companies will re-inhibit during operation.

Deviation from normal acidity may indicate loss of oxidation inhibitor. An up-to-date oxidation life test will prove the point.

So far we have mentioned the importance of selection of equipment. We have discussed routine performance tests, log sheet records, vibration readings and records, and lubrication.

These all play a part in learning when a unit must be torn down. Considerable work can be done on bearings and other parts of the oil circuit during short outages. Checking of bearings may disclose irregularities inside a turbine by the load markings found.



WHICH ONE?

De Laval Oil Purifiers are supplied in types and sizes for every plant need. ***All*** types . . . straight Oil Purifier . . . "Uni-Matic" Oil Purifier . . . or "Puri-Filter" . . . perform the same basic function equally well — they all throw out of the oil by means of centrifugal force, all solid and liquid impurities. But each machine has its place.

The straight Oil Purifier is used where it is desirable to install separate pumps to carry the oil to and from the purifier. This type of De Laval machine comes in the widest range of capacities, from 5 gph to 1800 gph dependent on the viscosity of the oil being purified.

The "Uni-Matic" is built with its own pumps. When necessary, a heater is also supplied. It is ready to operate as soon as it is piped up to the oil supply.

The "Puri-Filter" is a complete De Laval "Uni-Matic" plus a set of three or more filters. The filters remove colloidal carbon and other minute contaminants that get into diesel oil, or remove fly ash from turbine oil. Because it combines centrifugal force and micronic filtration, it leaves oil visibly clean—practically transparent. Its capacity depends on that of its basic unit —the De Laval "Uni-Matic" Oil Purifier.

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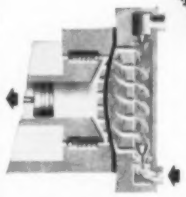
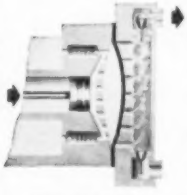


INTAKE STROKE



DISCHARGE STROKE

No packing or other leak-likely gland can be in contact with chemical being handled by the Lapp Pulsafeeder. A hydraulically-balanced diaphragm acts as a floating partition, without mechanical load or pressure differential—assures isolation of chemicals being pumped from all working pump parts. Pumps against pressures to 2,000 lbs., at constant pumping speed—variable flow for continuous processing results from variation in piston-stroke length-controlled by instrument air pressure responding to any instrument-measurable processing variable.

WRITE FOR NEW BULLETIN No. 300, just issued. 24 pages of description, specifications, typical applications, flow charts. Inquiry Data Sheet included from which we can make specific engineering recommendation for your processing requirement. Write Lapp Insulator Co., Inc., Process Equipment Division, 581 Maple Street, Le Roy, N. Y.

The foregoing procedures, carried out while the turbine is in operation, give you many valuable tips on what is happening inside the turbine while it is in service. Combined with factors related to system load, maintenance policies and the like, they aid in determining not only when to shut down the turbine for overhaul but also give valuable clues on what to look for when the turbine is opened for inspection. Another article will tell you in detail how to inspect the turbine after it is opened, what inspection tools you will need and just what to look for.

Boiler Feed Pumps

In many respects boiler feed pumps should be handled the same as turbine generators. Standardized tests, vibration indications, bearing behavior — all apply. Many other pumps will not be equipped with sufficient instruments to permit everyday comparisons, but fortunately the service on such pumps is usually less severe.

On high-duty pumps, a deficiency of 10 per cent usually indicates internal leakages of such magnitude that a rapid increase in damage can be expected. On lower orders of duty, it may be justified to permit a greater deficiency before general inspection and reconditioning.

Form for periodic standard conditions test

The heading will naturally include: Station name; Test Number; Unit Number; Date of this Test; Unit kw Rating.

Data should include:

(a) Total shaft load	Kw.....
(b) Total Steam to Turbine	M lb per hr....
(c) Steam Temperature Before Throttle	Deg F.....
(d) Steam Pressure at 1st Stage Nozzles	psia.....
(e) Back pressure at Turbine Exhaust	Inches Hg.....
(f) Number of Admission valves (or nozzles)	active.....
(Note these last four items should be controlled to predetermined values as accurately as possible)	
(g) Steam pressure before throttle	psia.....
(h) Steam pressure before each stage	psia.....
1-2-3 etc. (as many points as possible)	
(i) Barometer	Inches Hg.....

From the above a water rate is available. It and the load carried can be plotted on calendar cross-section paper to advantage.

If full Economy Tests are also run periodically other items of importance should be plotted. One of these is partial air pressure in the condenser as indicating physical condition of the condensing equipment.

Correction:
Reversible Pump Turbines Are Different

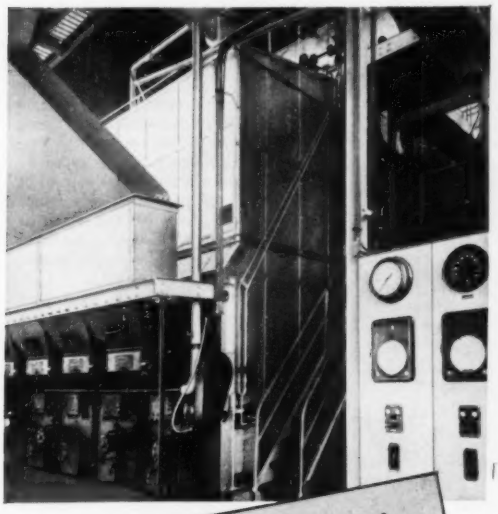
IN FIG. 4, page 65, May issue, the left-hand performance curves carry a scale of brake horsepower that should have read 5000 to 20,000 instead of 500 to 2000 — that is, the brake horsepower scales on both parts of Fig. 4 should be the same: 5000 to 20,000.

"HOW WE SAVE MORE THAN $90,000 A YEAR—

BY BURNING COAL THE MODERN WAY!"

says W. H. FISHER, Plant Engineer, Kerr Bleaching and Finishing Works, Concord, North Carolina.

"Powering our plant used to take nine boilers—now *one* does the same job *using 30% less fuel!* 6 firemen now do the work of 18—thanks to modern coal-handling equipment and automatic controls. That's why we say, you can't beat bituminous coal burned with modern equipment."



Above is a view of the plant's modern, space-saving coal-storage silo. To the left is a close-up of the firing aisle, showing the spreader stoker and the main control panel. Coal handling is automatic and dust-tight throughout. Automatic controls regulate firing, drafts and feed-water—give maximum efficiency at lowest cost.

If you operate your own steam plant, you can't afford to ignore these few down-to-earth facts!

COAL in most places is today's lowest-cost fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U. S. A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

Burning coal the modern way can save *you* money, too! First, labor costs can be cut to a minimum with up-to-date coal- and ash-handling equipment. On top of that, today's combustion installations give you 10 to 40% more power from each ton of coal than was possible a few years ago!

If you're planning to modernize, or if you're building a new plant, call in a consulting engineer. He'll show you how you can get big savings by burning coal in a modern plant designed to meet your *specific* needs.

America's coal reserves are virtually inexhaustible; America's coal industry is the world's most productive and efficient. That's why coal has a future dependability of supply that no other fuel can offer. That's why, of all fuels, the price of coal is most likely to remain stable.

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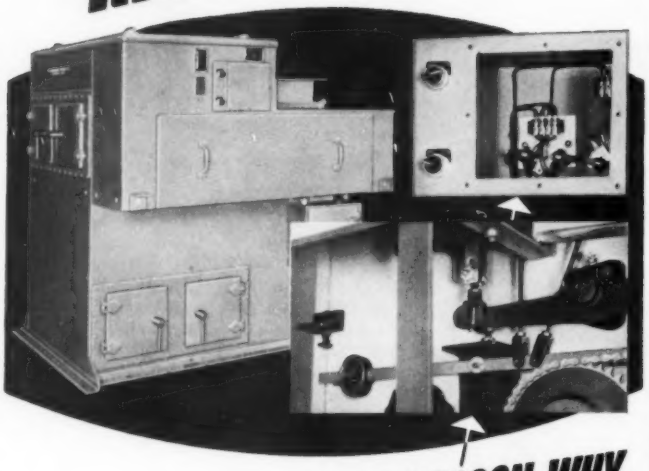

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New ENGINEERING BOOKS

Electrical Engineers' Handbook; Electric Communication and Electronics. Harold Pender and Knox McIlwain, Editors. Fourth Edition; 5¾ by 8½ in.; semi-flexible binding; published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, N. Y.; 1951. Price $8.50.

This Fourth Edition of Pender's Handbook follows the same plan adopted in the Third Edition: that of dividing the handbook into two volumes, one on Electric Power under the editorship of Pender, Del Mar and Knox McIlwain; the other (this volume) on electrical communication and electronics under the editorship of Pender and McIlwain. Of course, the subject matter is that of specialists in the respective divisions of the field. This edition is similar, in general, to the Third Edition, but new material on electronics has been added to keep pace with the rapid development in that field. In particular, frequency modulation and all the pulse techniques in both the communication and radar fields appear in this volume for the first time.

Muddy Waters: The Army Engineers and the Nation's Rivers, by Arthur Maass, with a foreword by the late Harold L. Ickes. First Edition; 306 pages; 6 by 8½ in.; cloth; published by Harvard University Press, Cambridge, Mass.; 1951. Price $4.75.

If for no other reason, this book is interesting because of the vigorous foreword by the former Secretary of the Interior, Harold L. Ickes. The U. S. Army Engineers are responsible for developing America's water resources for navigation, flood control, hydroelectric power and other purposes. How well the Corps of Engineers has done the job is a controversial question. The Hoover Commission Report strongly recommended reorganization of the Government's water resource function by consolidating the functions of the Engineers and the Reclamation Bureau of the Department of the Interior.

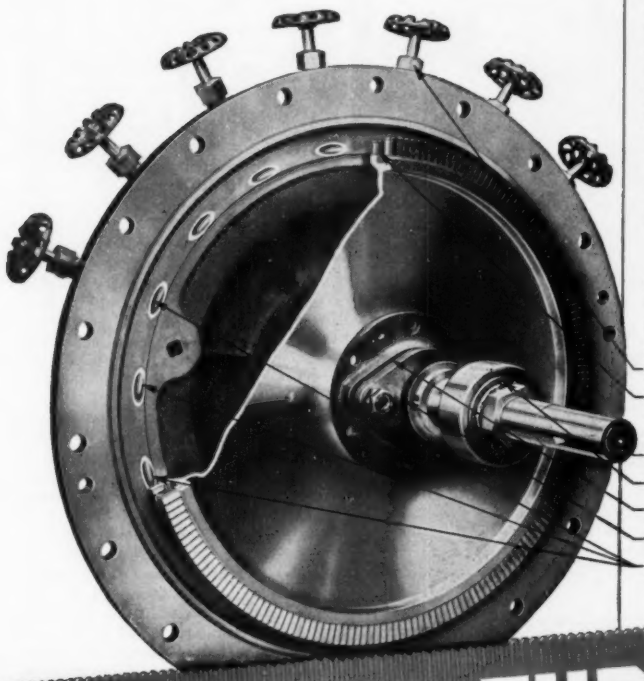
In this book, Mr. Maass, who is at present Assistant Professor in the Department of Government of Harvard University, shows why and how the public interest in natural resources and their development could be better served than it is now. He does not fail to explain the historical development which led to the present inefficient handling of the waterways. More than once the Corps of Engineers has run afoul of public policy, and agitation for proper action has been growing since the days of Franklin Roosevelt.

Mr. Ickes, who fought the Army Engineers over water use plans of the Federal

No other steam turbine offers you

SUCH VERSATILE STEAM NOZZLE CONTROL

The larger number of hand valves you see on a Coppus Steam Turbine promises you greater operating economy. At least 60% of the steam nozzles can be individually controlled to give maximum steam pressure in steam chest . . . a guarantee of best water rates at any load. Maintenance economy, too, is assured by the hard chromium plating of the shaft at the stuffing box. It provides the best possible smooth, non-corrosive surface for packing rings.



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Why waste money buying turbines with higher horsepower ratings than you need? The higher the horsepower rating, the higher the price. Save money by selecting the Coppus Turbine size closest to your requirements from 150 hp down to fractional. And when you do, you save operating and maintenance costs, too. That's what these other Coppus features are designed to do: exclusive pilot operated excess speed safety trip supplementing constant speed governor; choice of metallic or carbon ring packing assemblies. Designs available for back pressures up to 75 pounds; replaceable cartridge type bearing housings. For full details . . .

WRITE FOR BULLETIN 133

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- Stuffing box with metallic packing ring
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Little stories of big savings in LAGONDA tube cleaning

The case of the Experimenting Refinery

• One of the big eastern refineries, experienced in cleaning their tube stills mechanically, the Lagonda way, figured they'd try the same method on their power boilers to see how costs compared with the approved chemical method formerly used. They found out a lot. Cleaned all tubes inside and out in two large B.&W. boilers, and even with the labor costs of mechanical cleaning, they saved actually *more than two thirds* over chemical cleaning charges! Did it faster, too, which is certainly an item.

Just shows it doesn't pay to take some things for granted—and it does pay to try out Lagonda tube cleaning. Why not do it soon?

Y2-2

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Government during his service as Secretary of the Interior, minces no words in discussing the activities of the Corps of Engineers. Indeed the "Old Curmudgeon" is at his vigorous best in his denunciation of their practices. "One way to describe the Corps of Engineers," says Mr. Ickes, "would be to say that it is the most powerful and most persuasive lobby in Washington. The aristocrats who constitute it are our highest ruling class. They are not only the elite of the Army, they are the perfect flower of bureaucracy."

As Mr. Ickes points out, when the Army Engineers demean themselves to report to anyone in the Government, it is to Congress. Their record shows that they are not only independent of the Secretary of Defense but even of the President. When Herbert Hoover was in the White House the Corps of Engineers casually brushed him aside, although he himself was a member of their profession.

Regardless of whether anyone may agree with Mr. Ickes' bitter condemnation of the Corps of Engineers, one cannot escape the clarity of Dr. Maass' analysis of the operation of the Army Engineers, and this is a book which every engineer concerned about our national resources should read, and read carefully. Dr. Maass describes the *pork barrel* consequences of the Army Engineers relations with congressional committees, the conflicts with the Bureau of Reclamation, particularly concerning the King's River Project in California's Central Valley, and describes how such conflicts have prevented development of sound water policies. While he is at present Assistant Professor at Harvard, Dr. Maass has been an effective member of such government agencies as the National Resources Planning Board, the Bureau of the Budget, and the Department of the Interior.

Expansion Behavior of Coal During Carbonization, Institute of Gas Technology Research Bulletin 11, by O. P. Brysch and W. E. Ball; 60 pages; illustrated; size 8½ by 11 in.; paper binding; published by Institute of Gas Technology, Technology Center, Chicago 16, Ill.; price $5.00.

This bulletin, 11th in a series, presents the results of a critical review of literature on the expansion behavior of coal during carbonization, and a survey of industrial practice to determine the present state of the art of coal carbonization.

Some 700 references on carbonization have been scanned by the authors, and more than 200 of special importance abstracted and critically reviewed in preparing the report. First-hand inspection of current coke oven practices supplement this literature.

Included in the text are: a summary of significant opinions and findings from the literature; a study and analysis aimed at predicting expansion pressures of coal during carbonization by correlation with

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The pump testing facilities of the Allis-Chalmers research laboratories are available at the West Allis, Wisconsin, Works to all consulting engineers, utilities and power plant operators concerned with large pump operation. If this pump testing laboratory can help you, call your Allis-Chalmers District Office or write Allis-Chalmers, Milwaukee 1, Wis.

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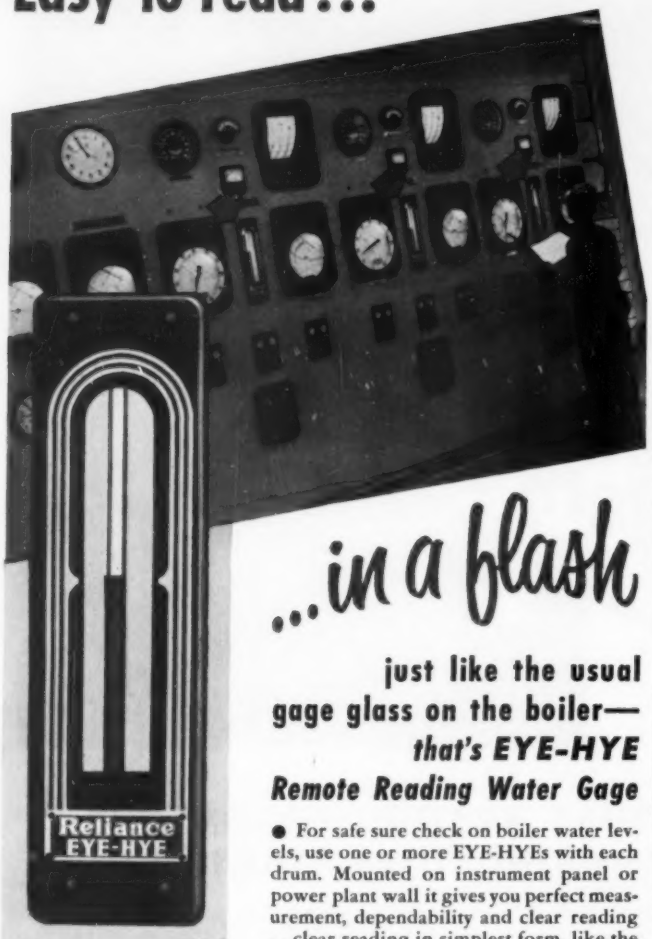

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just like the usual gage glass on the boiler— *that's* EYE-HYE *Remote Reading Water Gage*

● For safe sure check on boiler water levels, use one or more EYE-HYEs with each drum. Mounted on instrument panel or power plant wall it gives you perfect measurement, dependability and clear reading . . clear reading in simplest form, like the usual gage glass . . . clear reading in a column of brightly illuminated green fluid.

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its properties; and outline of concrete research proposals in an effort to uncover these correlations, if any. To date none are evident.

The report represents, to those interested, a complete and somewhat technical digest of what is and is not known about the behavior of coal during carbonization.

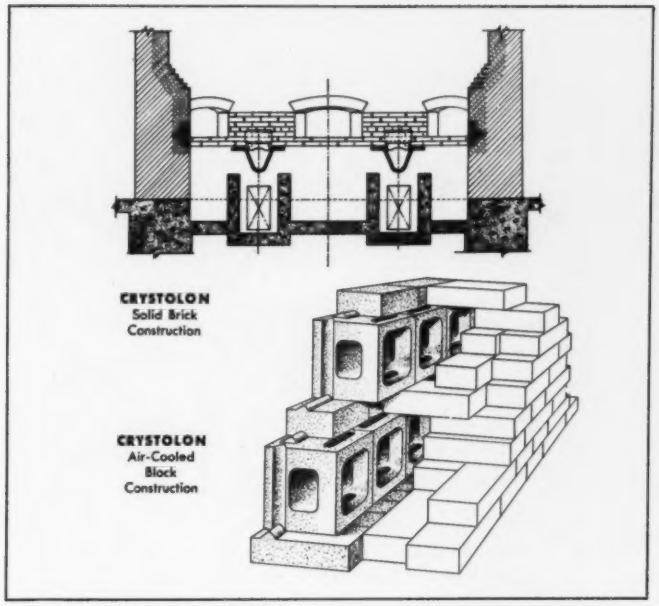
The Nature of Polyphase Induction Machines, by Philip Alger. First Edition; 397 pages; illustrated; 6 by 9¼ in.; cloth; published by John Wiley & Sons, Inc., 440 Fourth Ave., New York; N. Y.; 1951. Price $7.50.

Like most things familiar and utterly reliable, the induction motor has long been taken for granted. Only recently, at an exhibit of Silicone products (see May issue, page 7) there was an induction motor with part of its casing cut away and with turns removed from the stator winding to increase the heating effect, repeatedly being dipped into a tank of water while it kept running at normal speed. The water was virtually boiling as a consequence. More than anything else, this amazing performance demonstrated the *utter* reliability of the induction motor, which Mr. Alger discusses in this new book. As he points out, these two hundred million motors that operate our homes and farms, and give the power of nearly eight horses to every American factory worker, deserve our thoughtful attention. They present a world of challenging problems to the student and the professor, as well as to their designers and users.

In a single volume, Mr. Alger includes the basic principles of electro-magnetic phenomena and circuits to enable the engineer to calculate all phases of induction motor performance. He carries through the concept of energy being received, stored, transformed and delivered through all phases of motor performance. He gives more complete and accurate formulas for reactance, power factor, locking and crawling torques, and magnetic noise than ever before published. Indeed, a number of elements in the theories of reactance and locking torque are entirely new.

Another interesting feature of Mr. Alger's book is the two chapters devoted to the work of Gabriel Kron. It was Kron who asked himself the questions whether among all the varied and independently developed rotating machines there might not be a universal structure from which all possible types could be derived by simple laws — whether there is not some basic equation in modern physics that applies equally to all moving electrodynamic systems, be they spinning electrons or rotating machines. Kron found the answer in the tensor algebra.

Philip L. Alger is at present Consulting Engineer, in the Small and Medium Motors Division of General Electric Co.



Avoid Boiler Furnace Shutdowns...

with CRYSTOLON refractories protecting the "Trouble Zone"*

With the right kind of wall protection in your boiler furnaces, you cut shutdowns and maintenance costs to a minimum.

Norton CRYSTOLON (silicon carbide) refractory shapes — solid bricks or hollow air-cooled blocks — form a real "safety belt" for this trouble zone. That's because they offer outstanding protection against these three frequent causes of furnace failure:

High Heat. CRYSTOLON shapes are so highly refractory that they withstand temperatures up to 3100 F.

Slag Penetration. CRYSTOLON bricks and blocks, made with a maximum percentage of silicon carbide, are so structurally dense that even when clinkers adhere — which happens very rarely — they can be easily removed.

Abrasion. CRYSTOLON silicon carbide, being a tough abrasive itself, is not noticeably affected by the abrasion of the moving fire beds of stoker-fired furnaces.

Why waste time, trouble and money on refractories that spall, erode or crack? Investigate how quickly CRYSTOLON shapes pay for themselves with trouble-free service.

Norton RA1019 ALUNDUM* Cement adds extra life to furnace walls

One way to assure long lasting boiler furnace walls is to lay up your brick with Norton RA1019 ALUNDUM cement. Containing 80% fused alumina, this fine-ground, chemically stable cement matures at 1850 F and resists temperatures up to 3100 F — qualities that mean strong, thin, firmly sealed joints in both silicon carbide and fused alumina brick.

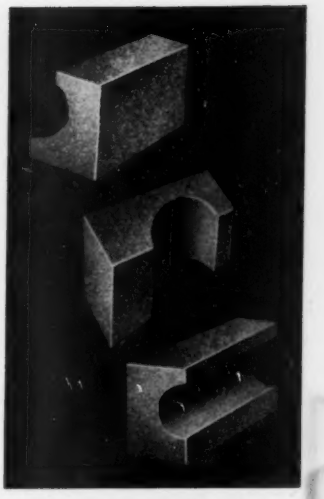
*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

NORTON

Special REFRACTORIES

Making better products to make other products better

NORTON COMPANY, WORCESTER 6, MASSACHUSETTS



CRYSTOLON Armor Blocks in your water tube boilers give low-cost protection against high heat

High refractoriness that stands up under today's increasing boiler furnace temperatures is just one big advantage of Norton CRYSTOLON Armor Blocks. In addition, they have great resistance to slag penetration and abrasion — plus the high thermal conductivity that promotes even heat distribution and affords maximum protection to tubes from localized heat generation and flame impingement.

Installation is easy and inexpensive. Adjoining surfaces of blocks are tapered, for secure locking and intimate contact with tubes. Bent or straight tube sections can be replaced from the fire side and are laid dry, further reducing installation costs. Tubes require no cleaning or grinding.

For prices and full information, send data on tube diameters, tube spacing, radius of curvature of bent sections and areas to be curved.

Know the Facts

These two Norton bulletins contain plenty of valuable information on the properties and selection of both refractory brick and cement. Ask your Norton Representative for Bulletins 862 and 863, or write direct to NORTON COMPANY, 621 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto, Ontario.

POWELL gives you flow control at its best!
Advanced engineering, laboratory control of all materials, expert workmanship and over a century of manufacturing experience make Powell Valves what they are today — flow control equipment at its best.
And because they are made to suit the service, there are more kinds of Powell Valves in use today than of any other individual make.
The Wm. Powell Co.
Cincinnati 22, Ohio
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES
DEPENDABLE VALVES
SINCE 1844

HELPFUL BULLETINS

CATALOG LIBRARY

EQUIPMENT NEWS

ADVERTISERS' INDEX

SPECIAL SERVICE

5 ways . . .

Power Engineering

. . . through REGULAR MONTHLY FEATURES helps you with your power engineering problems. . . . TWO POSTAGE-FREE CARDS are provided for you

1. Streamlines your job reading—

HELPFUL BULLETINS (starts on page 37) reviews for you recently published catalogs and bulletins. List item numbers of those you want on the post cards. You'll receive the literature from manufacturers at no cost to you

2. Gets you reference literature—

CATALOG LIBRARY (starts on page 105) offers standard manufacturers' catalogs and handbooks. List item numbers of those you want on the post cards on this page. The catalogs will be sent to you free by the manufacturers

3. Keeps you posted on new products—

EQUIPMENT NEWS (starts on page 42) describes new developments in power equipment. Use post cards for listing numbers of products you want to know more about

4. Provides information on advertised products—

ADVERTISERS' INDEX (see page 128) helps you to find advertised products quickly. Use the post cards to ask for free literature advertised, further product information, or the names and addresses of distributors in your locality

5. Gives you "extra help" when you need it—

SPECIAL SERVICE is as close to you as the post cards. Use these cards to ask for tear sheets of POWER ENGINEERING articles . . . manufacturers' names and addresses . . . help with a baffling problem . . . to notify us of a change of address . . . or comment on an article

FILL IN CARDS BELOW

TEAR OUT—MAIL

BUSINESS REPLY CARD

No Postage Stamp Necessary if Mailed in the United States

POSTAGE WILL BE PAID BY—

POWER ENGINEERING

1110 South Dearborn

CHICAGO 3, ILLINOIS

FIRST CLASS
PERMIT No. 353
SEC. 34.9 P.L.&R.
CHICAGO, ILL.

PLEASE PRINT OR TYPEWRITE

July, 1953
Card Valid to 7 months

POWER ENGINEERING

Please have the manufacturers send me without obligation information or bulletins indicated by the following numbers.

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Your Name.....

Your Title.....

Your Company Name.....

Company Address.....

City.....State.....

(If you prefer delivery at your home also fill below)

Home Address.....

City.....State.....

Also, use this card for more information on advertised products

FILL IN CARDS BELOW
TEAR OUT—MAIL

TYPE OR PRINT PLAINLY

Your Name.....
Your Title.....
Your Company Name.....
Company Address.....
City.....State.....
(If you prefer delivery at your home also fill below)
Home Address.....
City.....State.....

Also, use this card for more information on advertised products

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JULY, 1952
Card Void in 7 months

POWER ENGINEERING

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Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, may appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-free cards on page at left for your request

FUEL OILS, LUBRICANTS

201 Cooperative Technical Consultation Service — This informative 24-pp booklet presents company's periodic consultation service aimed at the most efficient use of petroleum products. Covers services available in the solution of lubrication problems, metalworking operations, processing, fuel and heating oils, dust control. Gulf Oil Corp., Gulf Refining Co. *(See ad on page 89 for information on turbine lubrication.)*

202 Lithium Soap Greases — Twelve-pp Booklet AD3084, on manufacturer's Stanolith greases, explains how they withstand both high temperatures and wet operating conditions. Discusses two grades — one recommended for central dispensing systems, and a heavier grade for compression cups or pressure gun applications. Standard Oil Co. (Ind.) *(See ad on page 45 for information on turbine lubrication.)*

203 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co. *(See ad on page 119.)*

204 Lubrication of Diesel Engines — An excellent instruction manual, 50-pp Technical Bulletin B-1 (revised) also provides a brief history on diesel engines, an explanation of the fundamentals of design and the common types of diesels and their advantages. Explains combustion process, discusses modern fuel injection systems. Cylinder and bearing lubrication are treated in detail and recommendations given for lubricating oils. A trouble-shooting chart included. Sun Oil Co. *(See ad on page 9.)*

205 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants. The De-Laval Separator Co. *(See ad on page 93.)*

206 Turbine Oil Conditioning — Bulletin 832-P, 12 pp, offers a detailed explanation of the reasons for turbine oil conditioning, the way in which company's dry type conditioning equipment nullifies or prevents factors which promote deterioration of oil. Bowser, Inc. *(See ad on page 90.)*

WATER CONDITIONING

208 Chlorination for Power Plants — Form RA-2061-C is a 20-pp technical article, "Recent Developments in Chlorination and Equipment for Power Plants." Discusses such subjects as industrial water chlorination, the desliming processes, air pilot chlorinator operation, organic slimes and scales, chlorine ammonia reactions, chlorine residual recording. Wallace & Tiernan Products, Inc. *(See ad on page 106.)*

209 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment. Dearborn Chemical Co. *(See ad on page 47.)*

210 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system provided. Worthington Corp. *(See ad on page 34 for information on deaerators.)*

211 Carryover Prevention — Eight-pp Technical Paper 115 discusses the role of anti-foam agents in the prevention of carryover of boiler water solids with steam. Covers mechanical and chemical influences on carryover, foaming and anti-foam action, types of anti-foam agents. W. H. & L. D. Betz. *(See ad on page 87.)*

212 What's New on Ion Exchangers — Here are three booklets on ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp. *(See ad on page 36.)*

214 Modern pH and Chlorine Control — This 100-pp booklet gives details on color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co. *(See ad on page 118.)*

215 Hot Process Water Softeners — Bulletin 2341, a 32-pp booklet, is crammed full of data on hot process treatment of boiler feedwater. A number of designs are discussed, including conventional and sludge-blanket types, with and without built-in deaerating equipment. Also described is the new two-stage hot process lime and zeolite softener. The Permutit Co. *(See ad on back cover for information on a mixed-bed demineralizer.)*

216 Organics in Water Treatment — Here's a folder describing need for organics in altering nature of sludge to make it non-adherent. Covers theoretical and practical considerations involved in use of organics. Power Chemicals Div., E. F. Drew & Co., Inc. *(See ad on page 25 for information on boiler corrosion prevention.)*

217 Feedwater Treating — Bulletin 1855, 30 pp, features manufacturer's hot process Accelerator for treatment of boiler feedwater, illustrating and explaining its operation and advantages, also optional equipment. Contains excellent discussion of necessity for treatment of makeup water, selection of proper equipment. Also covers limitations of hot process softening. Infilco Inc. *(See ad on pages 18-19.)*

BOILERS AND AUXILIARIES

218 Shop-Assembled Boiler — Eight pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock & Wilcox Co. *(See ad on pages 30-31.)*

219 Steam Generator — Bulletin 1050 describes a fully automatic generator in 10 to 500 hp capacities furnished completely equipped ready for installation. Cutaway drawing illustrates design of the unit; major parts are discussed, full dimensions included. Lists fuel burning equipment provided for use with light and heavy oils, gas, or combinations. Ames Irons Works. *(See ad on page 117.)*

221 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced. Copes Vulcan Div., Continental Foundry & Machine Co. *(See ad on page 116.)*

VALVES, TRAPS, PIPING AND ACCESSORIES

223 Check Valves — Twenty-pp Catalog 30 presents company's line of tilting-disc check valves made in iron, bronze and steel for working pressures to 3000 psi. Explains operating principle of tilting disc construction, discusses closing without slam, reduced loss of head, other advantages. Includes construction details, dimensions. The Chapman Valve Mfg. Co. *(See ad on inside back cover.)*

226 Iron Body Gate Valves — Bulletin 805, 8 pp, covers iron body, bronze trim gate valves in both outside screw and yoke and non-rising stem types, telling applications for each. Design features are explained. Gives dimensions, working pressures, and prices. The Ohio Injector Co. *(See ad on page 6.)*

227 Gate Valves — Literature is available on cast steel outside-stem-and-yoke gate valves; also on bronze, iron, steel and corrosion-resisting valves in a variety of types. The Wm. Powell Co. *(See ad on page 102.)*

228 Blow-off Valves — Illustrated Bulletin B-433, 24 pp, describes blow-off valves for high-pressure boilers, and covers seatless, hard-seat and unit-tandem types, for working steam pressures from 400 to 2500 lb. Construction details

WHY INSULATE YOUR CONDENSER TUBES?

You may be doing just that if your plans don't include CHLORINATION EQUIPMENT for slime control by WALLACE & TIERNAN.

Chlorination equipment because it controls slime that *grows* on the walls of condenser tubes not protected against it. Enough of the growth eventually seriously reduces heat transfer efficiency — actually *insulates* your steam from the cooling water. Back pressures go up, production drops, operating and maintenance costs rise, and eventual shut-down becomes necessary for regular clean-out periods.

Wallace & Tiernan equipment because it is versatile, sturdy and dependable — proven by thousands of successful installations, vouched for by satisfied users everywhere-and because there's a Wallace & Tiernan chlorinator for every job. Write today for information on how Wallace & Tiernan chlorination may help you solve *your* slime problem.

NO WATER IS SLIME-FREE regardless of the source. Chlorination helps reduce slime in make-up or cooling water.

CD-37

WALLACE & TIERNAN COMPANY, INC.

CHLORINE AND CHEMICAL CONTROL EQUIPMENT

NEWARK 1, NEW JERSEY • REPRESENTED IN PRINCIPAL CITIES

and operating principles illustrated. Dimensions and specifications included. Yarnall-Waring Co. *(See ad on page 54.)*

229 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co. *(See ad on page 124.)*

230 Solving Steam Trap Problems — This popular 36-pp catalog on steam traps contains specifications and capacities on steam traps, float traps, air release valves and pipe line strainers. Tells how to calculate condensation loads and select traps for all classes of equipment, including unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains and header drips. Gives pointers on how to install and service traps. The V. D. Anderson Co. *(See ad on page 29.)*

232 How to Install, Maintain Traps — Form 1722 is an 8-pp illustrated folder covering use of company's traps. Installation section covers location of traps, hookups, bypasses, use of strainers, other factors to be considered. A chapter on trouble shooting includes discussion of common troubles as well as mysterious and imaginary ones. Maintenance suggestions include testing methods and inspection procedures. Repair parts list included. Armstrong Machine Works. *(See ad on page 4.)*

233 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co. *(See ad on pages 10–11 for information on gage glasses.)*

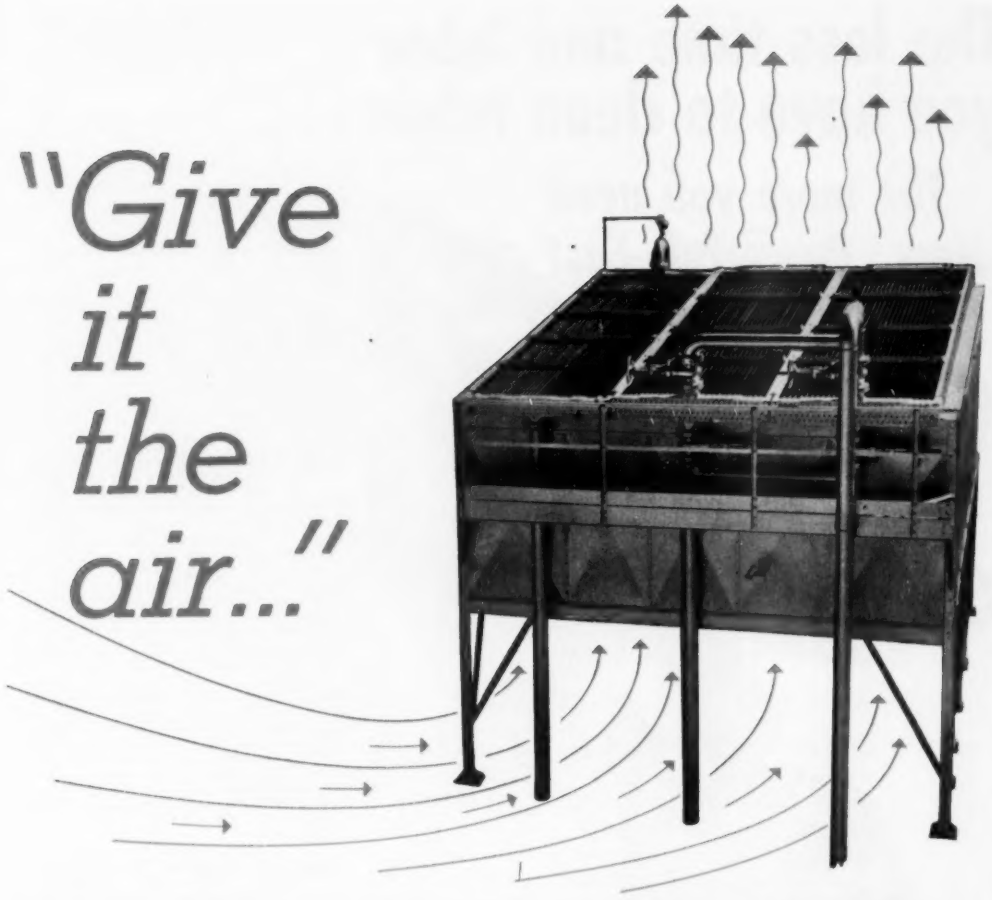
234 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb, expansion steam traps, weight-operated traps for steam, air, gasoline, and piston-operated steam traps. W. H. Nicholson & Co. *(See ad on page 114.)*

235 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co. *(See ad on page 43 for information on a pressure seal gate valve.)*

236 Forged Fittings — Literature is available on screw-end and socket-weld fittings. Stresses economy and other advantages of these fittings, lists steels available. Watson-Stillman. *(See ad on page 14.)*

237 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering

"Give it the air..."



now means...cool or condense the FIN-FAN way

AIR . . . not water . . . does the cooling or condensing in a Fin-Fan Heat Exchanger.

That means freedom from all water system complications, expenses, and troubles.

But that's only one of the many Fin-Fan benefits. With Fin-Fan, you get the superior heat transfer of the exclusive K-Fin helical cooling elements that have eleven times the external surface of the same length of bare tubes, you get a unit that can be built to withstand pressures up to 5000 psi and temperatures up to 1500F, and you can handle several different duties in a single installation.

This "package type" unit may be placed in any convenient location, operates independently of wind velocity and direction, and is simple and economical to operate and maintain.

Fin-Fan, developed jointly by Griscom-Russell and Fluor Corporation, Ltd., is widely used for practically every condensing and cooling service. Investigate Fin-Fan possibilities for your plant. Write for full information without obligation.

THE GRISCOM-RUSSELL CO., MASSILLON, OHIO

GRISCOM-RUSSELL

PIONEERS IN HEAT TRANSFER APPARATUS

The less time and labor you have to clean tubes

The more you need New, Powerful, Fast

ROTOJET TUBE CLEANERS

ROTOJET Air-driven Motor Model 525 with short 4-arm head and universal joint for 2⅛" to 3" I.D. curved tubes.

So powerful is the new Rotojet Motor that we have yet to find a scale-removal job tough enough to stop it. The simple, rugged Rotojet, with our exclusive Rotocentric bore cylinder, uses air sparingly. No leakage, no stalling at low speeds. Labor-saving air valve permits one-man operation. Try Rotojet and you'll never want to use any other make cleaner.

SEND FOR NEW ROTOJET BULLETIN

ELLIOTT COMPANY-ROTO DIVISION

147 Sussex Avenue, Newark 1, N. J.

and application data; includes a section on products for refrigeration service. Available to qualified power engineers; please give your title. Henry Vogt Machine Co. (*See ad on page 26 for information on film type exchangers.*)

238 Duplex Strainer — This literature describes company's Duplex strainer with single handwheel control. Shows how it is designed with only one stuffing box and can be cleaned under full flow. R. S. Products Corp. (*See ad on page 92.*)

PUMPS AND COMPRESSORS

239 For Controlled Pumping — Illustrated Bulletin 251, 24 pp, is of interest to engineers concerned with pumping practically any liquid from heavy viscous fluids to light solvents, solids in suspension, abrasive slurries, hot or cold liquids, liquefied gases. Describes company's motor-driven controlled volume pumps as well as models for special applications. Milton Roy Co. (*See ad on page 17.*)

240 Centrifugal Pump Handbooks — Two instruction booklets covering the installation, operation and repair of company's single-stage single-suction and multi-stage centrifugal pumps are available. Suggest regular inspection procedures and include pages for maintenance records. Also provide handy tables explaining how to locate trouble and listing causes and cures. Bulletin 08X7813, 24 pp, covers single-stage pumps; Bulletin 08X7780, 48 pp, covers the multi-stage pumps. State choice or both. Allis-Chalmers Mfg. Co. (*See ad on page 99.*)

241 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Worthington Corp. (*See ads on page 33 for information on condensers.*)

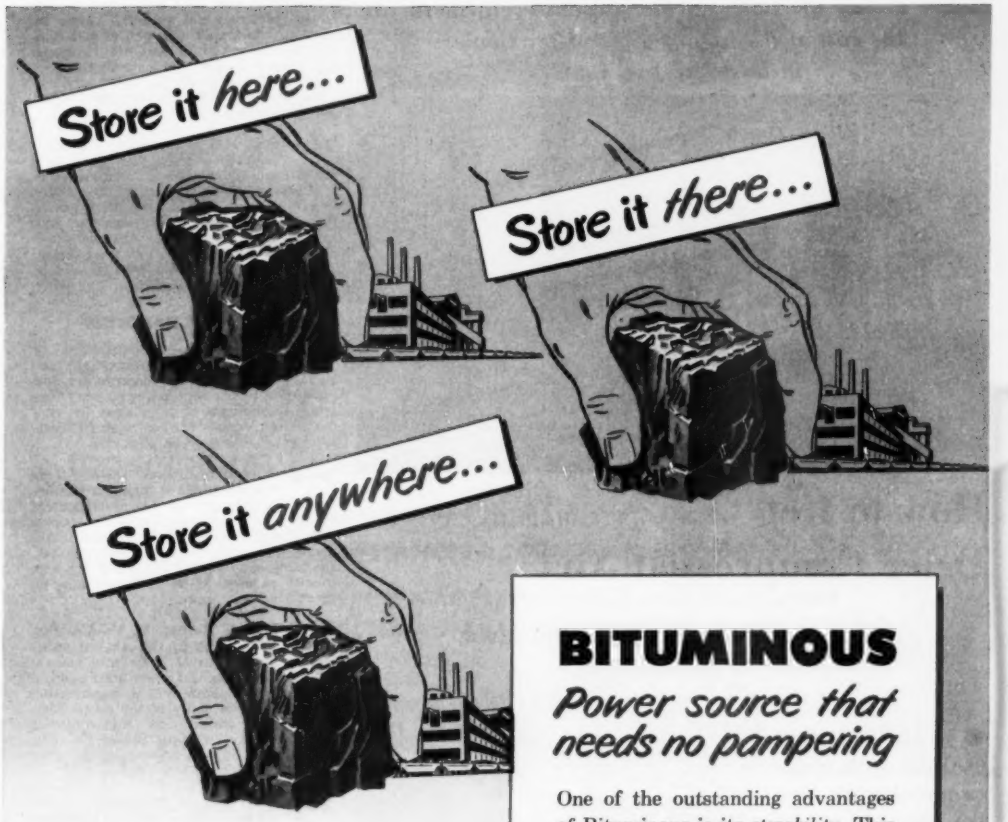
242 For Controlled Volume Pumping — Bulletin 300, 24 pp, describes Pulsafeeder piston-diaphragm pumps, stressing their no-stuffing box feature and noting that although basically a pump, this unit can do the work of a chemical feeder, a meter, an instrument, a filling machine, a proportioner and a sampler. Process Equipment Div. Lapp Insulator Co., Inc. (*See ad on page 94.*)

PACKINGS, GASKETS, SEALS

243 Manual on Packings — Containing 84 pp of engineering and ordering information, Catalog 40 covers packings for practically every service. Includes packaging recommendation charts, conversion tables. The Belmont Packing & Rubber Co. (*See ad on page 121.*)

244 Packings and Gaskets — Catalog P-100C, 32 pp, covers 95 most popular packings and gaskets in company's line, furnishing details of construction, service recommendations and size information. Includes charts showing specific recommendations for a wide variety of applications. Packing Div., Raybestos-Manhattan, Inc. (*See ad on page 18.*)

245 Packings for the Power Plant — Designed as a quick-reference aid, one feature of this compact 6-pp guide is a flow sheet of a rudimentary industrial

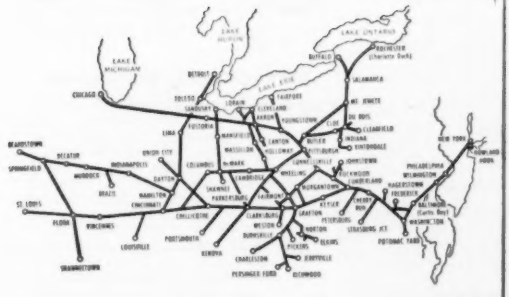


BITUMINOUS

Power source that needs no pampering

One of the outstanding advantages of Bituminous is its *storability*. This dynamic, low-cost fuel can be stockpiled anywhere—in any volume. Construction of storage facilities is not required when fuel needs increase.

Add to this the *excellence* of Bituminous mined along the Baltimore & Ohio, the wide *variety* available, and its *accessibility* through convenient transportation to industrial centers—and you have ample reason for choosing B&O coals. For helpful advice, *ask our man!*

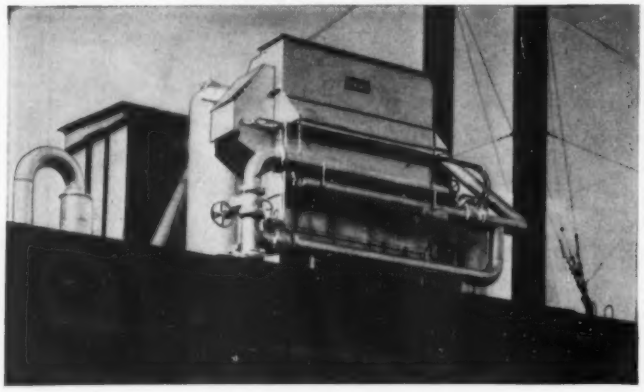


BITUMINOUS COALS FOR EVERY PURPOSE

BALTIMORE & OHIO RAILROAD

Constantly *doing things* — better!

Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.



How to Get Drier Compressed Air:

It prevents many troubles and saves much expense

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. E, 405 Lexington Ave. **New York 17, N. Y.**

Experienced District Engineers in all Principal Cities of U. S. and Canada

power plant with each unit keyed to the proper packings and gaskets. These, in turn, are illustrated with photos and construction information, sizes, etc. Packings and gaskets are grouped according to recommended applications and services. Johns-Manville. *(See ad on page 120 for information on condensate filtration.)*

246 **Seals for Bearings** — Complete information on manufacturer's Klozure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes mechanical pressure seals for rotary shafts. The Garlock Packing Co. *(See ad on page 24 for information on gaskets.)*

COAL, ASH HANDLING

247 **Coal Scale** — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co. *(See ad on page 96.)*

248 **Spreader Stoker Data** — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp. *(See ad on pages 12–13 for information on steam generating units.)*

249 **Where Refuse Is Fuel** — Presented in 24-pp Bulletin are installations of company's RotoGrate stokers with medium-size and larger units burning refuse fuels, separately or in combination with coal. Lists many of the refuse fuels handled successfully by this type of spreader stoker. Detroit Stoker Co. *(See ad on page 53 for information on other RotoGrate stokers.)*

250 **Why Liquid Diffusion** — What liquid diffusion can do for power plants is explained in Form B, which tells how liquid diffusion compounds work and gives four practical applications. These include dust control in coal handling, fly ash control, coal storage pile treatment and boiler cleaning. Johnson-March. *(See ad on page 125.)*

REFRACTORIES, INSULATION

251 **Refractory Brick** — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick. Norton Co. *(See ad on page 101.)*

252 **Heat Insulation** — This 8-pp booklet on hydrous calcium silicate insulation is illustrated with graphs, tables and drawings showing the numerous ways in which this insulation is used in industrial and commercial projects for temperatures up to 1200 F. Lists wide selection of shapes and sizes to insulate tubes and pipes from ¼ to 72 in. dia and vessels from 72 in. to 60 ft, also flat surfaces. Gives data on physical characteristics, recommended thicknesses. Kaylo Div., Owens-Illinois Glass Co. *(See ad on page 91.)*

INSTRUMENTS AND CONTROLS

254 **Pressure Regulator** — Bulletin 1-B, 8-pp discusses design, opera-

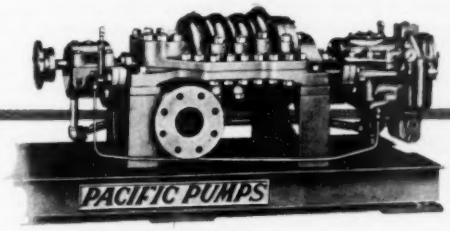
Specify BOILER FEED PUMPS by Pacific

for small and medium sized boiler plants

to insure

RELIABILITY... DURABILITY...
RESISTANCE TO CORROSION-EROSION

DEPENDABLE PERFORMANCE AND THE HIGHEST FACTOR OF AVAILABILITY AT ALL TIMES



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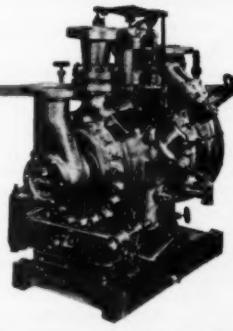
MULTI STAGE TYPE JBF

Capacities To — 1000 GPM
Discharge Pressures To — 1000 psi
Electric Motor Drive To 3600 RPM
Steam Turbine Drive To 5000 RPM



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SINGLE STAGE-UNITIZED
STEAM TURBOPUMP

Capacities To — 500 GPM
Discharge Pressures to 1100 psi
STEAM To 900 psi Pressure — 850° F. TT
Exhaust Pressures To — 50 psi
Speeds To — 10,000 RPM.

PACIFIC
Precision Built
PUMPS

Pacific Pumps inc.

HUNTINGTON PARK, CALIFORNIA
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BF-15

EVERLASTING
Boiler Blow-off Valves...

Teamed Up For "EVERLASTING" Service

The unique service qualities of EVERLASTING Blow-off Valves have long been demonstrated in boiler-rooms throughout the country. Now their superior design features have been teamed up in these new EVERLASTING Duplex Blow-off Units.

HERE'S WHAT YOU GET WITH THESE NEW DUPLEX UNITS

Sealing Valve (shown on left of unit)

- Lever- or wheel-operated types—as you desire
- Unrestricted flow — straight-through
- Rotating sliding disc—self-grinding, self-lapping
- Drop-tight seal—improving with use
- Non-wedge action — no sticking, no jamming

Blowing Valve (shown on right of unit)

- Straight-way or angle types to select from
- Strength to withstand repeated shock of blow-off force
- Exceptional resistance to erosion, abrasion and rust
- No pockets to permit lodgment of solids
- Positive action, self-cleaning

Not only do these EVERLASTING Duplex Blow-off Units provide an absolutely drop-tight seal — they are so constructed that long and repeated operation will not affect this tightness. Other Duplex Units for varied requirements are shown in our Bulletin.

Either valve of any EVERLASTING Duplex Unit can be supplied separately. But for boiler blow-off applications, any one of the complete EVERLASTING Duplex Units assures absolute safety — at low maintenance cost.

Ask your distributor — or write directly to us — for complete information.

EVERLASTING VALVE CO., 49 FISK STREET, JERSEY CITY 5, N. J.

EV 3308

Everlasting Valves

Trade-Mark "EVERLASTING" REG. U. S. PAT. OFF.

for everlasting protection

tion and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve. Atlas Valve Co. *(See ad on page 118.)*

255 For Centralized Control — Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co. *(See ad on page 113.)*

256 Instruments Control Systems — Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co. *(See ad on page 128.)*

257 Electronic Control System — Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co. *(See ad on page 49.)*

258 For Practical Men — This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co. *(See ad on page 88 for information on other testing instruments.)*

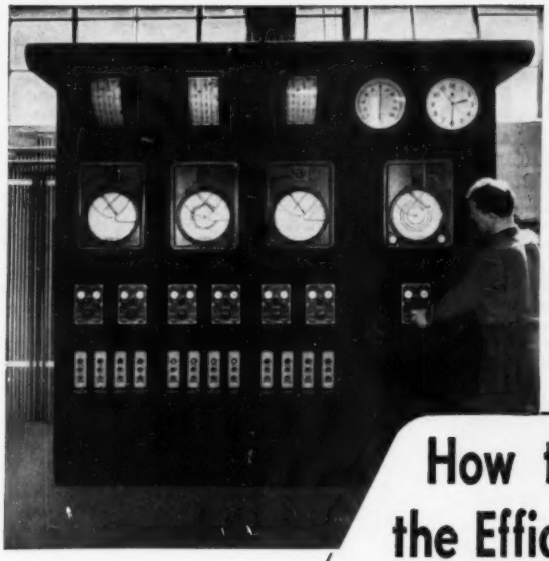
259 Easy Reading Gage — An all-hydrostatic remote reading gage for boiler water and other liquid levels is described in Catalog 500, Section CO. Pictures improved visibility, other advantages offered by this gage, explains operation. The Reliance Gauge Column Co. *(See ad on page 100.)*

260 For Combining Control Signals — The improved design of company's Ratio Totalizer is described and pictured in color in 8-pp Bulletin 5452. This simplified versatile mechanism is a pneumatically operated control for combining input control pressures and spring forces, and producing an output control pressure based on addition, subtraction, multiplication, division or other functions. Hagan Corp. *(See ads on pages 21 and 115 for information on other control equipment.)*

261 Temperature Instruments — This 100-pp catalog gives details about company's complete line of industrial glass, dial and recording thermometers, electronic temperature indicators and recorders. Fully illustrated, includes application information. American Industrial Instruments, Manning, Maxwell & Moore, Inc. *(See ad on page 52 for information on pressure gages.)*

COOLING

263 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for



These Bailey Boiler Controls at the Chicago Pneumatic Tool Company's new plant in Utica, N. Y. insure efficient operation of three 25,000 lb per hour, 100 psi, spreader stoker-fired boilers

How to INCREASE the Efficiency of YOUR BOILER-ROOM DOLLAR

Before you get steam you've got to spend dollars—so dollars are a form of energy.

And if your boiler-room dollars are invested in equipment that isn't working efficiently, economically, your "investment" is poor.

That's where co-ordinated controls by Bailey can help. Here's why they'll increase your "boiler-room investment efficiency":

1. **Complete Range of Equipment—fully co-ordinated.** You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, just because he has a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control systems.

2. **Engineering Service—backed by experience.** No other manufacturer of instruments and controls can offer as broad an experience, based on successful installations involving all types of combustion, flow measurement and automatic control.

3. **Direct Sales-Service—conveniently located near you.** Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum of travel time and expense.

•

For better "boiler-room investment" efficiency—for more power per fuel dollar, less outage and safer working conditions, you owe it to yourself to investigate Bailey Controls. Ask a Bailey engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record: "More power to you!"

A-111-0

BAILEY METERS

BAILEY METER COMPANY

1040 IVANHOE ROAD
CLEVELAND 10, OHIO

Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS

This Plant Claims Their

HEAT SAVINGS PAID for NICHOLSON TRAPS

Nicholson expansion steam traps were installed by a processor on tank heaters and coils where various unit temperatures from 160° to 185°F had to be maintained. The steam temperature was 320°F. Figuring the difference in heat loss between Nicholson traps discharging condensate at 160° and others discharging it at about steam temperature, they feel the loss was cut nearly in half. Due to their effectiveness in controlling temperature as well as draining condensate, Nicholson traps are paying for themselves in many industries.

For All Equipment Using Steam or Hot Water

CATALOG 751 OR SEE SWEET'S

Radiators, Separators, Paper Machinery, Pipe Coils, Kettles, Railway Coaches, Dry Kilns, Vulcanizers, Switch Heaters, Laundries, Molding Presses

160 Oregon St., Wilkes-Barre, Pa.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

Paracoil EVAPORATORS

for STATION HEAT BALANCE or FRESH WATER SUPPLY

Shop View of SALT AND FRESH WATER EVAPORATORS built by PARACOIL for San Juan Steam Electric Station, Porto Rico Water Resources Authority, San Juan, Porto Rico. Jackson & Moreland, Boston, Mass., Consulting Engineers

HERE'S A JOB WE'VE BUILT FOR SAN JUAN, P. R.

Wherever pure water is needed for boiler feed makeup, process work or general plant operation, a PARACOIL EVAPORATOR is a proven, time-tested means of handling any kind of initial raw water—salt or otherwise.

They are ruggedly built—dependable—and easily maintained. Specific requirements dictate the design. Our years of experience in building units of this type—and other power plant apparatus—assures you of the correct solution to your problem. *We invite your inquiry.*

DAVIS ENGINEERING CORPORATION

1062 East Grand Street, Elizabeth 4, New Jersey

30 Rockefeller Plaza, New York 20, New York

processing operations. Niagara Blower Co. *(See ad on page 110 for information on after coolers.)*

264 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc. *(See ad on page 15 for information on other cooling towers.)*

265 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, having helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co. *(See ad on page 107.)*

TOOLS

267 Pipe Tool Book — This catalog and data book gives information on pipe and bolt machines, power units, ratchet threaders, reamers and cutters, other power and hand tools. Includes "operating guide" section. Fully illustrated. Beaver Pipe Tools. *(See ad on page 117.)*

268 Tube Cleaners — Bulletin Y-29, 28-pp, describes and illustrates tube cleaners for all purposes. This handy guide covers applications of tube cleaners for removing scale and other types of encrustation from tubes or pipes in boiler room equipment, oil refineries, process plants and other locations. Gives hints on the care, operation of cleaners. Lagonda Div., Elliott Co. *(See ad on page 98.)*

269 Tube Cleaners — Catalog 76-A provides 48-pp of information on manufacturer's line of tube cleaners. Following equipment selection and operating hints, this practical catalog describes and pictures cutter heads and drill heads, brushes, and motors, giving sizes, application information. Electrically driven equipment, air valves, hose, lubricators and equipment presented. Thomas C. Wilson, Inc. *(See ad on page 125 for information on a curve-tube motor.)*

270 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co. *(See ad on page 108.)*

OTHER EQUIPMENT

272 Enclosed Motors — Construction features and details of totally-enclosed, fan-cooled motors with tube-type air-to-air heat exchangers in ratings from 40 hp at 600 rpm through 800 hp at 3600 rpm are described in Bulletin 51B749B. Points out that these motors come in standard and explosion-proof designs. Allis-Chalmers Mfg. Co. *(See ad on page 39 for information on large two-pole cage motors.)*

273 Magnetic Drive Engineering Data — Publication 1107 is a 32-pp booklet on precision speed control with adjustable speed magnetic drive. Technical in scope contains information on both magnetic drive and company's magnetic amplifier Regutron speed control. Data is clarified through charts and diagrams. Electric Machinery Mfg. Co. *(See ad on page 51.)*

sometimes, only the *best* is good enough!

IF a parachute or a combustion control system doesn't work just right—the user is in for a loss.

A boiler burns millions of dollars worth of fuel during its service-life. A combustion control system which wastes as little as one per cent of this fuel will cost you many thousands of dollars—even five, six, or seven times what the control system itself cost.

That is why only the best combustion control system is good enough. Hagan Combustion Control Systems utilize your fuel accurately, automatically, economically, dependably.

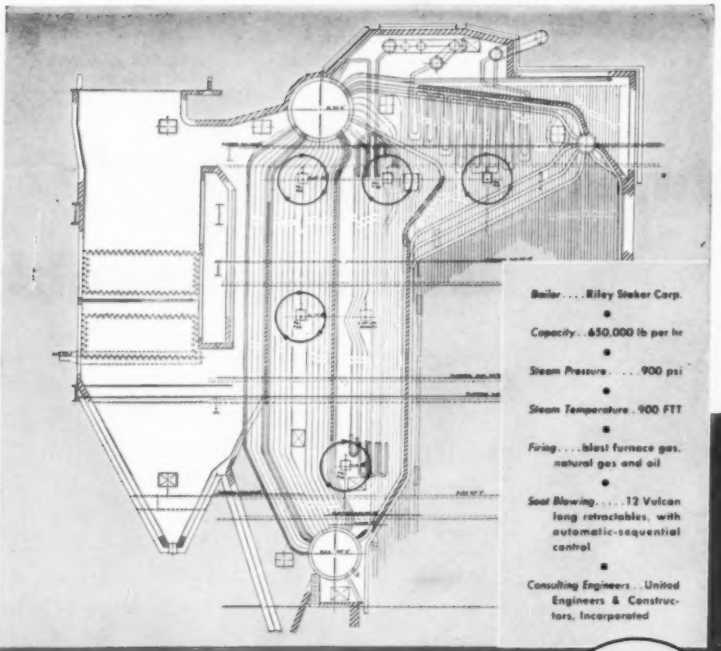
Hagan Corporation's engineers have extensive experience with all types of combustion control applications—a prime reason for their position of leadership. For more information *write, wire or phone*—

HAGAN HALL BUROMIN CALGON

HAGAN CORPORATION

HAGAN BUILDING, PITTSBURGH 30, PA.

BOILER COMBUSTION CONTROL SYSTEMS
RING BALANCE FLOW AND PRESSURE INSTRUMENTS
METALLURGICAL FURNACE CONTROL SYSTEMS
THRUSTORQ FORCE MEASURING DEVICES


Boiler . . . . Riley Stoker Corp.
Capacity . . 650,000 lb per hr
Steam Pressure . . . . 900 psi
Steam Temperature . 900 FTT
Firing . . . . blast furnace gas, natural gas and oil
Soot Blowing . . . . . 12 Vulcan long retractables, with automatic-sequential control
Consulting Engineers . . United Engineers & Constructors, Incorporated

VULCAN at

UNITED STATES STEEL COMPANY

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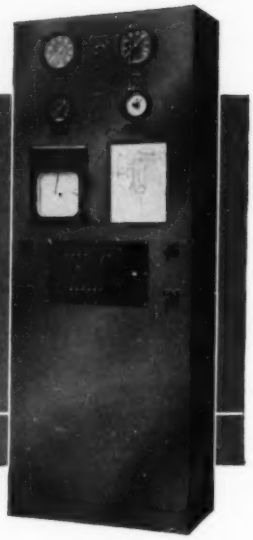


This boiler is cleaned by simply pushing a button. Operators need not even leave the panel to check the operation of the blowers, for the Vulcan Automatic-Sequential System reports back on each step in the cleaning cycle.

The story of Vulcan Automatic-Sequential Cleaning is told in Bulletin 483. Write for it.

From this panel, the operator can check each step of the cleaning cycle. Blowing medium is steam, but Vulcans can use steam or air or both without change in equipment. Control here is by air, but Vulcan also offers electric drive.

COPES-VULCAN DIVISION
CONTINENTAL FOUNDRY & MACHINE COMPANY
ERIE, PENNSYLVANIA

VULCAN *Automatic Soot* **BLOWERS**

274 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Everlasting Valve Co. *(See ad on page 112 for information on blow-off valves.)*

275 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co. *(See ad on pages 2-3.)*

277 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. National Airoil Burner Co., Inc. *(See ad on page 124.)*

278 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp. *(See ad on page 114.)*

279 Gas Burners — Illustrated Bulletin 410-8, 16 pp, furnishes descriptive and technical data on company's gas burners and combination gas and oil burners, giving design details and explaining operation of each type. Coppus Engineering Corp. *(See ad on page 97 for information on steam turbines.)*

280 Friction Tape — Three types of friction tape are described as to properties and application in Form M-8343. They include a high grade tape for all electrical work, a good general purpose tape that's competitively priced and available in two widths, and an extra strong tape. United States Rubber Co. *(See ad on page 35 for information on an ozone and moisture resisting tape.)*

281 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water. Foster Wheeler Corp. *(See ad on pages 22-23.)*

282 Oil Burning Equipment — Bulletin O-B 37 contains 16 pp of technical information on company's oil and gas burning equipment, steam atomizing burners, mechanical atomizing burners, interchangeable burners, telling best applications, including capacity data. Also shows fuel oil pumping, heating systems. The Engineer Co. *(See ad on page 16.)*

283 Synthetic Coatings — Specially engineered coatings for use in pump rehabilitation, condenser tube and sheet protection, valves, concrete, steel and transite piping, and condenser sealing are discussed in illustrated bulletin. Also describes an acid-proof coating for cooling tower structures. Synco Corp. *(See ad on page 122.)*

HELPFUL BULLETINS

(Continued from page 58)

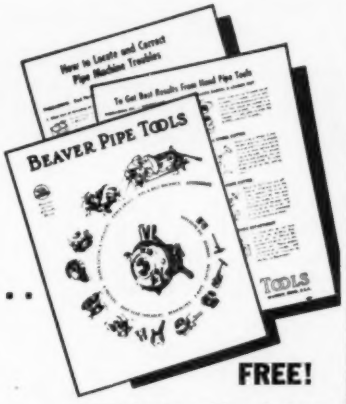
139 Pneumatic Conveying Systems — Four basic types of conveying systems built by this manufacturer are illustrated by photos and sketches of actual installations in 8-pp Bulletin G-1. Covers stationary and portable Fuller-Kinyon systems for dry pulverized materials; the Airveyor for dry pulverized, crushed and granular materials; the Airslide for dry, fine materials, and the Fuller-Flexo for dry pulverized materials. Fuller Co.

PUMPS

140 Controllable Capacity Pumps — Data Sheet 65A describes applications, features, design and operation of company's Powr-Savr pumps — plunger type units with a mechanism which controls length of plunger stroke and thus controls delivery without requiring a change in speed of pump motor, turbine or other prime mover. Includes sectional and dimension drawings, ratings and diagrammatic layout of an automatic hydraulic stroke-control system for boiler feeding oil supply burner. The Aldrich Pump Co.

141 All-Purpose Centrifugal Pump — Form S-100 is a specification folder covering company's new Model

NEW DATA BOOK makes your job easier . . . .



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- 1952 Catalog and Data Book gives you technical information on Beaver Pipe and Bolt Machines and Hand Tools. Illustrated throughout.
- A number of pages are devoted to an "Operating Guide" that tells how to locate and correct pipe machine and tool troubles. Clarifies thirty-one problems.
- Now available! Write for your free copy today!

BEAVER PIPE TOOLS

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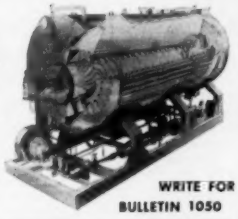
AMESTEAM GENERATOR

I Bought One Because It's

EASY TO INSTALL
EASY TO OPERATE
EASY TO CLEAN



10 to 500 h.p.
15# to 200# w.p.
OIL or GAS

WRITE FOR BULLETIN 1050

AMES IRON WORKS
BOX M-7, OSWEGO, N.Y.

Builders of Better Boilers Since 1848

ATLAS
Type "D" Reducing Valve

The exceptional valve shown below is our ATLAS Type "D". In our 52-page Bulletin 1-A it is shown as Fig. 171. Be sure to ask for Bulletin 1-A if interested as that bulletin gives complete information including cross-sectional views, list of parts, etc.

Ever since its introduction, Type "D" has made very much of a "hit" with engineers. It is unusually simple. Also gives accurate and close regulation of pressures. Is easy to inspect. Equipped with single seat renewable discs of composition or metal. Stainless steel valve stem. Removable diaphragm top. Adaptable to steam, air, or gas. Up to 175 lb. per sq. in. pressure. Durable. Body of bronze. Screwed ends. And, its construction gives it true balance with double port seats.

Be assured of best regulating valve service by always putting your regulating problems in the hands of ATLAS engineers. For more than a half century we have been specializing solely in regulating valves. See the list of principal ATLAS Power Plant Products below. Make use of the coupon.

ATLAS VALVE COMPANY
REGULATING VALVES FOR EVERY SERVICE

293 SOUTH ST., NEWARK 5, N. J.

Represented in Principal Cities

☐ Without obligation, please send me the ATLAS Regulating Valve Bulletin No. 1-A. Also, please send complete data on the following products:

☐ Damper Regulators	☐ Pump Governors
☐ Temperature Regulators	☐ Oil Control Cocks
☐ Exhaust Control Systems	☐ Humidity Controllers
☐ Pressure Regulators	☐ Thermostats
☐ C'mpbell Boiler Feed Water Regulators	☐ Balanced Valves
	☐ Control Valves

Name .....

Firm .....

Address .....

P-104 centrifugal pump, a compact, hermetically sealed unit, submersible and suited to handling a wide variety of liquids. Maximum capacity is given at 1000 gal at zero head. Three types of starting arrangements are described. Kenco, Inc.

OTHER EQUIPMENT

142 Graphitization Research Study — This interesting 12-pp booklet discusses graphitization phenomena in systems operated at high temperatures in the power and processing industries. Based on a 10-year research program, this study covers nature of graphitization and its effects and lists preventive and corrective measures. Illustrated with photomicrographs pf metallurgical specimens, booklet also contains eutetic diagrams and graphs showing effect of temperature, time and other variables. Edward Valves, Inc.

143 New Data on Zeolite Softeners — Publication 4520-A is a recently revised edition of company's booklet on zeolite water softening. Provides a glossary of terms used in the process, data for laying out a zeolite softening plant, factors governing size of equipment, selection of zeolite materials and discussion of the four stages of operation of a sodium zeolite softener. Also describes company's single control valve for manual or automatic operation. Cochrane Corp.

144 O-Ring Engineering Handbook — Extensive and helpful information on the selection and use of O-rings is provided in this 48-pp book. Tells how to choose O-rings and order them, defines terminology and includes excellent general O-ring gland design information on installations for pressures to 500 psi, for pressures not over 1500 psi and for those in excess of 1500 psi. Full dimensional data given. Plastic and Rubber Products Co.

145 Integrated Cooling System — This bulletin introduces company's Combin-aire cooling system, a combination of water cooling tower and air-cooled exchangers housed in one structure and designed to combine economical maximum use of air with minimum use of water. Tells of reduced piping requirements, other advantages; and how it is intended to do the work of three cooling units. Hudson Engineering Corp.

146 Multi-Louver Dryer — Detailed description of company's multi-louver dryer and how it works is included in 24-pp Bulletin 2409, followed by typical layouts, dimensional data and a psychometric chart. In addition, there is information on drying, cooling and processing of bulk materials. Especially important is its use in drying fine coal, and applications in the food, chemical process and fertilizer industries. Basic principles of heat drying are also discussed. Link-Belt Co.

147 Oil Damped Solenoids — Here is a close look, by means of photos and line drawings, at two models of dual oil-damped solenoids adaptable for cushioned motion with moderate power requirements. Cam operated micro-switches help give a smooth, quiet, hand-like motion to the dual solenoid. Twelve-pp booklet, includes performance charts and circuit diagrams. Scully Machine Co.

148 Why Colloidal Graphite — Bulletin 421 contains photos, diagrams, charts and information on the advantages of colloidal graphite over other

YOU CAN
REDUCE BOILER SCALE
WITH PROPER pH AND PHOSPHATE CONTROL

TAYLOR
BOILER WATER COMPARATORS WITH GUARANTEED COLOR STANDARDS

MAKE pH AND PHOSPHATE DETERMINATIONS QUICKLY, EASILY AND ACCURATELY!

In just one or two minutes you can get accurate readings of boiler water pH, phosphate and nitrate content with the amazingly simple Taylor Comparators. They're easy to use, require no fragile single standards . . . each plastic slide houses a complete set of color standards for any one determination. And, Taylor Color Standards carry an UNLIMITED GUARANTEE AGAINST FADING! The entire set . . . slides, base, reagents and accessories is housed in a convenient carrying case. NO TECHNICAL TRAINING is necessary to use Taylor sets. Complete instructions with each. Ask your dealer soon.

FREE DATA BOOK

YOURS FOR THE ASKING!

96 pages, including factual data on pH, phosphate and chlorine control in 34 basic industries. Also illustrates, describes and gives prices of Taylor sets. Write for your copy today.

W. A. TAYLOR AND CO.
410 RODGERS FORGE RD • BALTIMORE 4, MD

FROM THE TOP STEEL PRODUCER . . .
TO A LEADING CHEMICAL HOUSE,
A YEAST COMPANY
AND A MEAT PACKER . . .

Heat Prover SERVES 62 DIFFERENT COMPANIES IN THE GREAT CHICAGO INDUSTRIAL AREA!

The Cities Service Heat Prover is graphically proving its worth to all kinds of industry in the Chicago area and elsewhere throughout the country.

62 different companies, producing everything from steel to beef, have found the Heat Prover an important aid to increased production and big dollar economy.

WHEREVER A FURNACE OPERATION IS INVOLVED, Heat Prover can help increase productivity by providing:

1. **Rapid, continuous sampling.**
2. **Simultaneous reading of oxygen and combustibles.**
3. **Direct measurement of oxygen and combustibles.**
4. **Easy portability.**
5. **No maintenance; no re-calibration.**

REMEMBER: Heat Prover is not an instrument you buy but a service we supply. Contact the Cities Service office in your area and learn how Heat Prover can serve you . . . or write CITIES SERVICE OIL COMPANY, Dept. G 23, Sixty Wall Tower, New York City 5.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

petroleum lubricants in the assembly and run-in of engines and machinery. Stresses smoother bearing surfaces, close tolerances, lower bearing temperatures, lower oil consumption resulting from use of colloidal graphite. Acheson Colloids Corp.

Postage-free cards for ordering catalogs and bulletins are provided for you on page 104

149 Here's How to Solder — This little 16-pp booklet will fit in your shirt pocket, but it covers the fundamentals of soldering. Contains simple instructions and illustrations aimed at making soldering more successful and easier to do. Takes you step by step from choice of alloy through application of solder, outlining correct procedure to form a strong joint. Federated Metals Div., American Smelting and Refining Co.

150 Cylinder-Finish Tubing — Bulletin R-7 describes company's Rockrite cylinder-finish tubing, showing how this compression-formed tubing can eliminate machining of cylinder-bore or individual pistons for clearance adjustments. Also shows how the Rockrite process tends to iron out pits, scratches, other irregularities. Tube Reducing Corp.

151 Hazard Takes a Holiday — The increased safety afforded by the use of company's disconnecting and lowering lighting fixtures is stressed in 8-pp Bulletin TH-52. Besides general information, contains schematic layouts and descriptions of indoor installations in sloping and flat-roof industrial structures, as well as recessed and concealed-type mountings. Outdoor installations also covered. Accessories and their applications are explained. The Thompson Electric Co.

152 Industrial Hose Assemblies — Crammed with dimensions, uses and prices for all types of rubber hose assemblies, 8-pp Catalog 3 gives specific data for rubber tube and couplings for vari-purpose, paint and solvent spray, hydraulic and lubrication assemblies. Both medium and high pressure hose specifications are given for hydraulic uses. Information for all assemblies is augmented by photographs. Carlyle Rubber Co., Inc.

Leaf assembly being removed from one of three vertical filters at B. F. Nelson.

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increased condensate in boiler feed 70%

with SORBO-CEL®

When B. F. Nelson Mfg. Co. added new 425-psi boilers, oil in condensate was an expensive problem . . . until they switched to Sorbo-Cel filtration.

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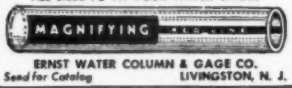

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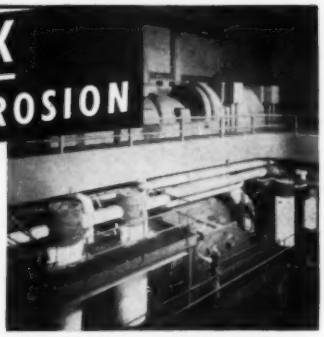

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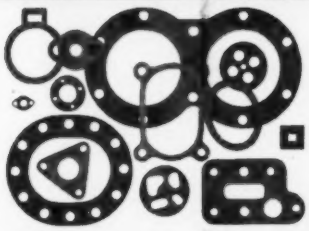

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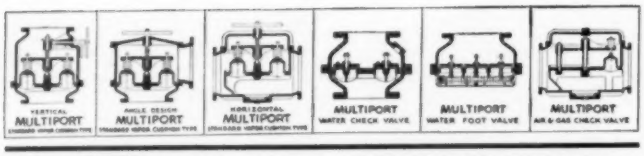

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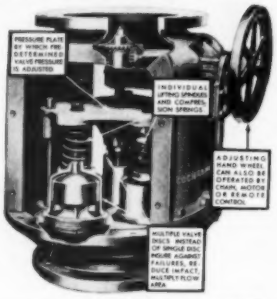
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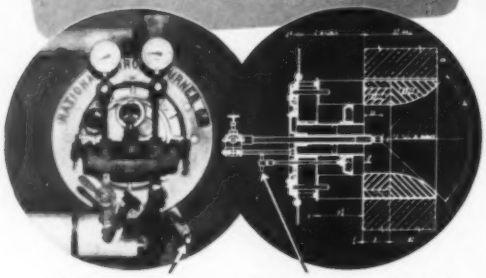

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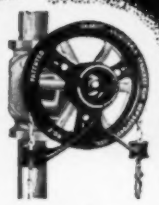

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EASY CONTROL! Easier than direct manual operation.

SAVES MONEY! Avoids accidents, permits piping short-cuts, saves piping costs.

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• Here's easy, convenient, instant control of overhead, out-of-reach valves — right from the floor! Four simple, quickly-assembled parts and the valve handwheel is ready to operate.

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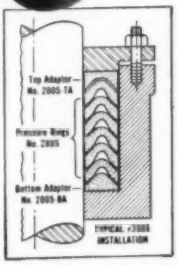

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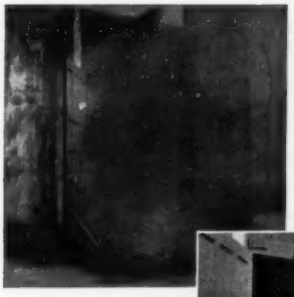

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America's Flagship . . .

The S. S. UNITED STATES

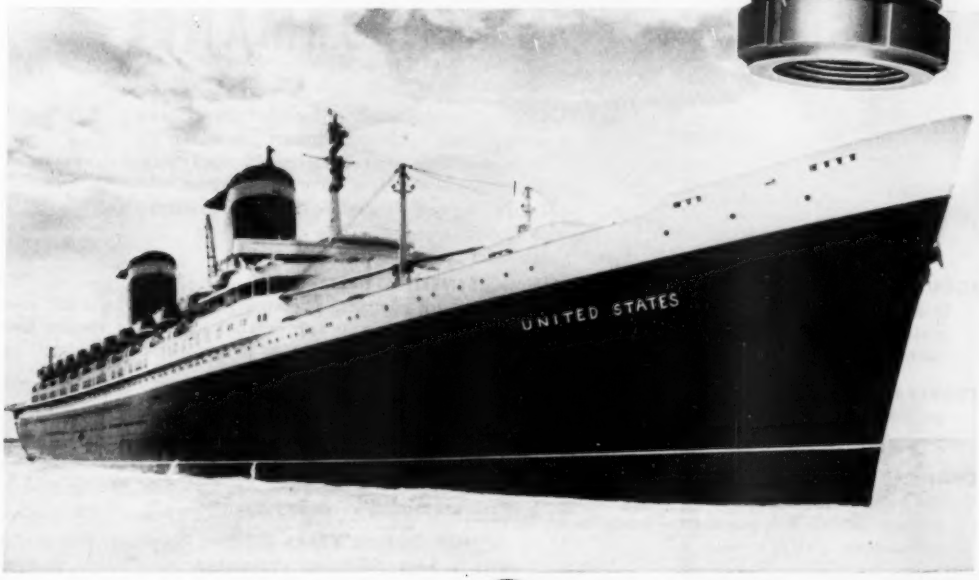
. . . a $70,000,000 investment protected by REPUBLIC FIRE HOSE

This luxuriously appointed goliath is the largest steamship ever built in our country. It is also one of the world's largest structures of any kind—afloat or ashore!

Designed by the famous naval architects, Gibbs & Cox, Inc., and built by the country's foremost shipbuilders, Newport News Shipbuilding and Dry Dock Company, the S.S. United States will soon be ready to challenge all comers for speed, comfort and safety of travel across the North Atlantic.

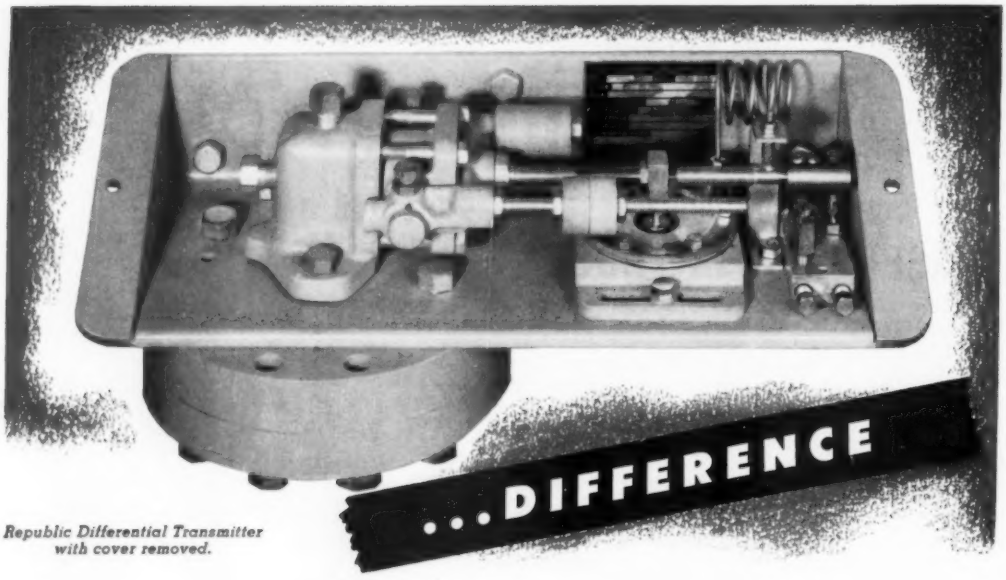
Republic Rubber is proud to have served the builders of this great ship. The thousands of feet of Republic Fire Hose selected for duty aboard this vessel will provide the highest degree of safety for passengers, crew and cargo.

We hope the hose never sees action. But should necessity arise you can bet it'll turn in an outstanding performance—typical of all Republic Industrial Rubber Products!



INDUSTRIAL RUBBER PRODUCTS BY
REPUBLIC RUBBER DIVISION
Lee Rubber & Tire Corporation
YOUNGSTOWN, OHIO

• The supership United States is built to carry 2,000 passengers, a 1,000-man crew and to convert, if necessary, into a transport for 14,000 troops. Secret features of design enable the 4½-block long leviathan to steam 10,000 miles without refueling. The Republic Fire Hose used on this installation is built with long-lasting rubber tube surrounded by a double jacket of flawless cotton fabric.



Republic Differential Transmitter with cover removed.

Spells *PLUS* PERFORMANCE

The Republic Pneumatic Transmitter combines machine ruggedness with instrument precision to provide matchless performance in measuring flow, level, pressure or density of a wide variety fluids. By any or all of the following points, the Republic challenges comparison:

ACCURACY of the Republic force-balance principle is higher than can be consistently secured and maintained with any other method. 1/2 of 1% guaranteed.

TEMPERATURE variations of ambient atmosphere have negligible effect on the accuracy of the Republic transmitter.

CHANGES IN AIR SUPPLY PRESSURE do not affect the accuracy of a Republic transmitter to any significant extent. A 5 psi change produces an error of less than 1/10%.

CHANGES IN LINE PRESSURE—Republic differential transmitters are not affected by variations in line pressure. A patented and exclusive simple adjustment assures this protection.

SENSITIVITY—Due to the negligible motions required for complete operation of all parts, for a full scale change, no appreciable hysteresis results from reversal of direction of measurement change.

VIBRATION of any normal frequency has no effect on the Republic transmitter.

LEVELING—Since all parts are balanced, and no liquid is used for calibration, Republic transmitters need not be leveled exactly, and may be adjusted for installation in any position.

FOR TWELVE YEARS Republic Pneumatic Transmitters have delivered unmatched performance in every type of installation. Complete details of design and operation, plus numerous application suggestions are combined in Data Book, 1002. Send for your copy, today.

REPUBLIC FLOW METERS CO.

2240 Diversey Parkway, Chicago 47, Illinois

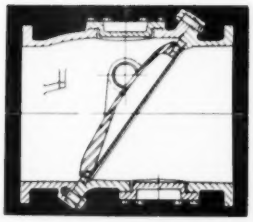
Here's the One "TILT" that Pays Off On the Level!...

the TILTING DISC in CHAPMAN'S CHECK VALVE

Yes, this is on the level . . . Chapman's Tilting Disc design offers you savings in head loss 65% to 85% over regular swing-type check valves.

For this Tilting Disc rides the flow . . . cushions itself to a quick, *quiet* closure right at the instant when there's no velocity in the line. There's no slamming, under usual pipeline arrangements. So there's no jarring of the line, no opening of the joints, no wear of moving parts worth mentioning. And seating is *drop-tight*.

Certified engineering test-results are charted in Catalog No. 30. Take a look at these tests . . . and then figure what Chapman Tilting Disc Check Valves can save for *you*. Send for your copy now.



Cross-section of the Chapman Tilting-Disc Check Valve. A feature of the design is that the disc seat lifts away from the body seat when opening, and drops into contact when closing, with no sliding or wearing of the seats.

THE CHAPMAN VALVE MFG. CO., INDIAN ORCHARD, MASSACHUSETTS

Permutit Research in Ion Exchange Produces Higher Efficiency Demineralization . . .

99.99995% PURE WATER

WITHOUT DISTILLATION!

PERMUTIT MIXED BED DEMINERALIZER DELIVERS WATER PURER THAN ASTM REQUIREMENTS FOR REAGENT WATER*

Reduction of electrolytes to less than 0.2 ppm (specific resistance approximately one million ohms—cm) and silica to less than 0.05 ppm is readily obtainable. In actual practice, specific resistance as high as 24 million ohms—cm has been achieved. Purity of Permutit Mixed Bed Demineralized water exceeds ASTM requirements by over one full decimal place. By comparison, most commercial distilled water contains from 2 to 10 ppm electrolytes. Yet the cost of distillation far exceeds that of Mixed Bed Demineralizing for most normal water supplies, requires more time, and uses equipment that takes up far more valuable space.

**Tentative specifications for Reagent water, ASTM designation D-1193-51T*

In the Mixed Bed Demineralizer, Permutit has developed equipment to produce water with total electrolytes less than 0.2 ppm, silica below 0.05 ppm. It is a single unit ion exchanger containing both anion and cation exchange resins in a homogeneous mixture. In one single stage, many separate demineralizing steps are provided, so that mineral impurities reach the vanishing point. The residual content is so low that conventional methods of analysis cannot be used for accurate determination, and conductivity measurements are customarily used. The types of ion exchangers—both anion and cation—can be varied to meet individual requirements for which the Mixed Bed Demineralizer is used. Through such variation, the Demineralizer can be applied to many different uses. The latest development by Permutit is *fully automatic control!*

For further information, write to The Permutit Company, Department PE-7, 330 West 42nd Street, New York 36, N. Y.

PERMUTIT

ION EXCHANGE HEADQUARTERS FOR 40 YEARS